Investment Management

S. R. Vishwanath • C. Krishnamurti
Editors

Investment Management

A Modern Guide to Security Analysis and Stock Selection

Springer

Editors

Professor S. R. Vishwanath
Institute of Management Technology
Nagpur, India
srvishy@gmail.com

Professor Chandrasekhar Krishnamurti
Mail Number B-3
Business School
AUT University
Private Bag 92006
Auckland 1142, New Zealand
Chandrasekhar.krishnamurti@aut.ac.nz

ISBN: 978-3-540-88801-7 e-ISBN: 978-3-540-88802-4
DOI: 10.1007/978-3-540-88802-4

Library of Congress Control Number: 2008941072

Cover design: WMXDesign GmbH, Heidelberg

Printed on acid-free paper

springer.com

Preface

The purpose of this book is to provide students with a realistic view of the role and activities of an equity security analyst within the investment process by building a construct of how capital markets function and teaching the "thought process" involved with securities analysis. The book will focus on three aspects of securities analysis: (1) understanding the process of analyzing companies; (2) understanding the valuation process; and (3) understanding the challenges of achieving success in a highly competitive capital market.

The focus of this book is on the financial theory and empirical evidence that are useful for investment decisions. The topics covered in this book can be broadly categorized into five groups:

- *Financial Theories*: This includes portfolio theory, the capital asset pricing model, and the arbitrage pricing theory, all of which have become an integrated part of the decision-making in investments.
- *Empirical Evidence in the Equity Market*: This includes patterns in cross sections of stock returns and the time series behavior of stock returns.
- *Introduction to Fixed-Income and Credit Sensitive Instruments*: This includes default-free as well as defaultable bonds; yield curve analysis; fixed-income derivatives such as swaps, caps, floors, and swaptions; models of default and ratings transitions; and more recent development of credit derivatives.
- *Market Efficiency and "Active" Investments*: We start with the efficient market hypothesis, which is a useful framework for modeling financial markets. Like any model, the efficient market hypothesis is not a perfect description of reality: some prices are almost certainly "wrong." Hence there are reasons to believe that active management can have effective results. Topics in active investments include security analysis, active portfolio management, hedge funds, and risk management issues.
- *Introduction to Behavioral Finance*: While traditional finance assumes investors act rationally to maximize a well-defined utility function, behavioral finance tries to use other theories of behavior, from psychology, sociology, and anthropology,

to explain financial markets. This topic will be covered by just one chapter, the main purpose of which is to get you exposed to this active and fast growing field in Finance.

Book Objectives

A sound investment decision requires in-depth knowledge of the financial markets and rigorous analytical thinking. The main objective of this book is to teach you these three elements:

- *Analytical Tools*: Among others, an important analytical skill you should acquire from reading this book is the ability to transform a real life investment problem into an analytical model. This modeling skill is an important aspect of this book.
- *Quantitative Skills*: Modern finance has its quantitative aspect. Powerful mathematical techniques such as optimization, dynamic programming, probability theory, and statistical analysis pave way for many complex investment problems. In this book, you will be exposed to this quantitative aspect.
- *Empirical Knowledge*: Essential to any investment decision is the knowledge of the investment environment. Broadly speaking, the financial instruments can be categorized into equity, debt, and derivatives. Important empirical evidence from all three types of financial markets will be examined in this book.

Contents

Contributors

Dr. Paul Ali is an Associate Professor in the Melbourne Law School and a member of the Law School's Centre for Corporate Law and Securities Regulation. He has published widely on banking and finance law, corporate governance and institutional investment law, securitization law, and structured finance law. In 2006, he was appointed by the Federal Attorney-General as a member of the Personal Property Securities Review Consultative Group.

He is currently undertaking research in connection with a major ARC Discovery Project Grant, and is also working on two book projects concerning derivatives and securitization law.

His most recent publications include the following:

Expansion and Diversification in Securitization, The Hague: Kluwer Law International, 2008 (with J.J. de Vries Robbé)

Secured Finance Transactions: Key Assets and Emerging Markets, Globe Law and Business, London, 2007

R. Chandrasekar is currently with Capital Metrics Investment Advisors Ltd. as a Principal. He was earlier the Dean of the Institute for Financial Management and Research in Chennai, India; a Vice President and Portfolio Manager at Dimensional Fund Advisors Inc. in Santa Monica, California; and a Financial Economist at the Chicago Board of Trade. He has an MBA from the University of Chicago and an MA from the Delhi School of Economics, India.

Kevin Cheng joined Parallax Capital Management in 2003 as an Associate. Parallax Capital Management (Parallax) is an alternative investment management company based in Singapore and in the Cayman Islands. Its focus is on alternative investment products in Asia, including private equity, overlay management, and venture capital. Prior to joining Parallax, he was with Aberdeen Asset Management in London as an analyst with the Global Fixed Income Team.

In 2002, he founded Global Derivatives, an online resource on derivatives pricing models and one of the largest portals for quantitative finance in the world. He graduated with a Bachelor of Science degree in Business Management from King's College London and holds the Certificate in Quantitative Finance.

Petko Kalev has an M.Sc. in Statistics and a Ph.D. from the University of Melbourne. He has taught in the Department of Statistics at the University of Melbourne, the Department of Econometrics and Business Statistics at Monash and at the Monash Business School. His research interests are in Initial Public Offerings, Term Structure of Interest Rates, and Volatility Modeling. He teaches Empirical methods in Finance at the doctoral program level.

Pratip Kar holds an MBA degree in Finance from INSEAD, and a banking certificate from the Indian Institute of Bankers, besides being a post graduate in solid state physics.

He had a long career at the Securities and Exchange Board of India (SEBI), which he joined when it was set up in April 1988. As the Executive Director of SEBI, since 1992, Pratip has played a key role in the reform of the Indian securities market, framing its regulatory policy and framework as well as implementing the regulations in diverse subjects such as the primary market, disclosure norms, accounting standards, corporate governance, takeovers and substantial acquisition of shares, foreign institutional investment, mutual funds, automation and modernization of the stock exchanges, the insider trading regulations, the regulations of the stock exchanges, demutualization of stock exchanges, regulation of the equity, bond and derivative markets, risk management, dematerialization of securities, clearing and settlement systems, surveillance and investigations, and policy research. In the area of corporate governance, he was involved in the preparation of the reports on corporate governance of the two committees set up by SEBI and in the preparation of Clause 49 of the listing agreement and in its implementation.

He also has a rich experience in international regulations and has been a regular participant at the meetings of the International Organization of Securities Commissions, the OECD, and the World Bank in the areas of securities market and corporate governance.

He has been a member of a number of high powered committees set up by the SEBI, the Reserve Bank of India, and Ministry of Finance, Government of India as well as by the IOSCO, the OECD, and the World Bank.

Currently, he is also on the Board of Governors of the National Institute of Securities Market set up by SEBI.

A gold medalist in graduation, he is also a National Merit and National Science Talent scholar. His early banking career included working with a commercial bank, Industrial Finance Corporation of India, and Industrial Development Bank of India (project finance).

Chandrashekar Krishnamurti is an Associate Professor at the Auckland University of Technology, New Zealand. He has held teaching positions at the Monash University, Australia; National University of Singapore; Nanyang Business School, Singapore; and the Indian Institute of Science. He has a Ph.D. in Finance from the University of Iowa, USA. He has a wealth of teaching, research, and consulting experience having worked in the US, India, and Singapore. He is especially interested in market microstructure, risk management using derivatives, emerging markets, and international finance. He has been a consultant for the Financial Institutions Reform and Expansion (FIRE) project funded by USAID and administered by Price Waterhouse LLP, USA. He has utilized his wide-ranging research expertise to conduct studies in Nasdaq, New York Stock Exchange, Paris Bourse, and stock exchanges in emerging countries. He has written a regular (MoneyGuru) column for Lycos Asia's Finance Portal (sg.finance.lycosasia.com) covering topics of interest to individual investors.

His main areas of research are in Corporate Finance and Market Microstructure. His secondary research interests include Emerging markets, International Finance, and Risk Management. He has conducted executive training in Derivatives and Risk Management, Investment Strategies for Individual Investors. He has published in major international journals such as Financial Management, Journal of Banking and Finance, Journal of Financial Research, Quarterly Journal of Business and Economics (USA), The ICFAI Journal of Applied Finance (India), Research in International Business and Finance (USA), and Managerial Finance (UK).

He has presented his research at major conferences around the world.

Ravishanker Mateti holds masters degrees in Management and Economics from Bombay University as well as a Ph.D. in finance from the University of Connecticut, Storrs. He is on the faculty of Charlton College of Business, University of Massachusetts at Dartmouth. His teaching and research interests are in the area of derivatives, risk management, and financial engineering.

Krishnamoorthy Narasimhan is a Vice President, Fixed Income Strategy at J P Morgan Securities in New York, where he is responsible for building and maintaining the quantitative CMBS performance models. He was the Director of Quantitative Financial Research at Fitch Ratings, New York, between February 2005 and March 2007.

He holds a Ph.D. from the Fuqua School of Business, Duke University. He served on the faculty of Wharton School, University of Pennsylvania, during July 2003 and September 2004 before joining the industry. He has presented his research at major universities in the US, Europe, and Asia.

Ignacio Vélez-Pareja is Finance Professor at Universidad Tecnológica de Bolívar in Cartagena, Colombia. He has published in several international journals, including Latin American Business Review, Quarterly Review of Economics, and Finance and Management Research News. He has published several books on Valuation in English and Spanish such as Principles of Cash Flow Valuation (Academic Press, 2004) with Joseph Tham from Duke University, Decisiones de inversión (5th Edition) (Editorial Javeriana, 2006), and contributed a chapter (Valuating Cash Flows in an Inflationary Environment The Case of World Bank, in Barbara T. Credan (Editor) to Trends in Inflation Research (Nova Publishers, 2006). He has posted many papers on the subject in the Social Science Research Network, RePec, and Economic Analysis Working Papers (EAWP). All his works can be found at http://cashflow88.com/decisiones/cursodec.html. Mr. Vélez-Pareja has more than 40 years experience in teaching and management in private firms.

Laurence Siegel is director of investment policy research at the Ford Foundation in New York, where he has worked since 1994. Previously, he was a managing director of Ibbotson Associates, an investment consulting firm that he helped to establish in 1979. Larry is chairman of the investment committee of the Trust for Civil Society in Central and Eastern Europe and serves on the investment committee of the NAACP Legal Defense Fund. He also assists the investment committees of numerous other nonprofit organizations. He serves on the editorial boards of *The Journal of Portfolio Management* and *The Journal of Investing*, and was the founding editor of *Investment Policy* magazine. Larry received his BA in urban studies and his MBA in finance from the University of Chicago.

Jithendranathan Thadavillil is an Associate Professor of Finance at the University of St. Thomas, St. Paul, Minnesota. He obtained his Ph.D. in finance from the City University of New York. He has published research papers in financial intermediation, international finance and investments. His dissertation on currency futures options won the Oscar Larson award for the best dissertation in Business at the City University of New York. Prior to his teaching career, he has worked in the areas of accounting and management in various countries around the world.

Joseph Tham is a visiting Assistant Professor at Duke University's Sanford Institute of Public Policy and the Duke Centre for International development. He is a social sector economist, with a doctorate from Harvard University. At the Centre for International Development, he is the co-director of the 18 week Executive development Program in Public Policy and Management for the state administration for Foreign Experts Affairs (SAFEA), Peoples Republic of China. In collaboration with Ignacio Velez Pareja, he has written a book titled Principles of cash Flow Valuation published by Academic Press in 2004.

In 2002 and 2003, he lectured at the Harvard University's Kennedy School of Government. He has worked in China, Gautemala, India, Malaysia, Saudi Arabia, Sri Lanka, Uganda, Vietnam, and Zambia.

Barton Waring joined BGI in 1995 and has run its Client Advisory Group since 1996. He has an extensive background in classical investment strategy and policy, asset allocation, and quantitative investment management, gained from his prior work with large defined benefit and defined contribution plans in both consulting and advisory roles. He received his BS degree in economics from the University of Oregon, his JD degree from Lewis and Clark, with honors, and his MBA degree in finance from Yale University.

S.R. Vishwanath is on the faculty of Emirates Institute for banking and financial studies, Sharjah, UAE. He has held academic positions at IMT, S P Jain, and several other business schools in India. He was a consultant with the Tata Management Training Center in Pune, India, during 2006–2007. His first book Corporate Finance: Theory and Practice published by Sage Publications is now in second edition. He has edited a book on Mergers, Acquisitions and Corporate Restructuring for Sage Publications and a book on Advanced Corporate Finance for Prentice Hall (India).

Chapter 1
Introduction

S.R. Vishwanath

1.1 Chapter Introduction and Objectives

Foreign investment in emerging stock markets is at record levels. Many emerging markets are yielding fantastic returns (see the data given further). Stocks in many markets are trading at stretched valuations. At no point in time before has security analysis and stock selection been more challenging. Professional analysts and fund managers are required to be abreast of the latest research coming out of universities to construct models and trading strategies. This book provides a comprehensive review of key theories, models, and framework. In this chapter, we provide an overview of the role played by financial markets and the process of security analysis (Table 1.1).

The chapter has the following objectives:

- Highlight the role played by financial markets
- Provide an overview of the process of security analysis and stock selection

World financial markets continued to grow and become more liquid in the 2000s, as the stock of global financial assets (equities, corporate and government debt securities, and bank deposits) reached $140 trillion, more than three times the global GDP.[1] The United States, UK, the Eurozone, and Japan account for more than 80% of the total. The United States continues to be the largest market with $50 trillion worth of assets, followed by the Eurozone ($30 trillion), and Japan ($19.5 trillion). The composition of stock varies across nations. Japan, for instance, has a large government debt market, whereas China has substantial bank deposits.

In 2005, worldwide cross-border capital flows, which include foreign purchases of equity and debt securities, cross-border lending, and foreign direct investment,

S.R. Vishwanath
Institute of Management Technology, 603, Khullar Apartments, Byramji Town,
Nagpur 440001, India
e-mail: srvishy@gamil.com

[1] Mapping the Global Capital Market, Third annual report, McKinsey & Co, January 2007

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_1,

Table 1.1 Performance of stock markets around the world (2006–2007)

Index	Annual return (%)	Country
DJ Mexico	+17.60	Mexico
DOW	+9.07	USA
S&P 500	+4.68	USA
NASDAQ	+9.08	USA
TSX	+6.73	Canada
Bovespa	+49.96	Brazil
FTSE Eurofirst 300	+4.30	Europe
DAX	+22.83	Germany
FTSE 100	+4.95	UK
FTSE 250	−3.90	UK
CAC 40	+4.17	France
Ibex 35	+10.79	Spain
JSE	+28.26	South Africa
FTSE Xinhua 200	+169.98	China
Hang Seng	+50.85	Hong Kong
S&P/CNX 500	+70.24	India
JSX	+59.28	Indonesia
Nikkei	−4.24	Japan
ASX	+20.86	Australia
NZX	+1.82	New Zealand

Source: www.ft.com

Exhibit 1.1 Total cross-border capital inflows, $ trillion

Year	% of global GDP
1980	4.6
1982	3.4
1984	3.6
1986	5.5
2000	14.2
2002	7.2
2004	12.1
2005	13.9

Source: McKinsey

increased to more than $6 trillion. Since 1990, cross-border capital flows have grown by 10.7% annually, outpacing growth in world GDP (3.5%), trade (5.8%), and financial stock (8.7%). Although most investors still show a preference for the financial assets of their home countries, roughly one in four debt securities and one in five equities are now owned by investors outside the local issuing markets. Exhibit 1.1 presents the statistics on cross-border capital flows.

1.2 Firm and the Financial Market

A financial market is a market where financial assets are traded. Financial assets are marketable financial claims issued by government and companies. Financial markets enable effective allocation of capital among competing uses. Financial markets perform four important economic functions. First, they enable individuals to choose more effectively between current and future consumption. Borrowing enables individuals to consume more whereas lending enables them to postpone consumption. The interest rate is the price of exchange. The units that have a surplus of capital invest in those that have a deficit. This provides producers with resources in excess of those generated by income. Second, the interaction between buyers and sellers in a financial market determine the price of a traded asset, say stocks, or alternatively, return demanded by investors to invest in a company. Firms can raise capital if the return on their investment exceeds the return demanded by investors. Third, financial markets provide liquidity to investors. That is, the owner of the asset can sell off the asset in the market place to realize cash whenever required. The degree of liquidity may vary according to the nature of the asset and the financial market in question. Fourth, stock markets process the opinion of all market participants and place a value on the company's stock. If you wish to find the value of GE's equity, all you have to do is take out a financial daily, note down the prevailing price of GE stock, and multiply it by number of outstanding shares. Thus, financial markets aid the process of price discovery. It would be very difficult to assess the performance of companies in the absence of active stock markets.

1.3 Are Financial Markets Shortsighted?

A manager is successful if he or she is able to raise the firm's stock price. The usual allegation is that financial markets do not react rationally to corporate actions in pricing stocks. This could be due to the following reasons:

- Nonavailability of information
- Inefficiency of the stock market

In many countries, the disclosure norms are inadequate. It is quite possible that managers may not disclose adequate information or give a biased picture. It is the job of security analysts to unearth information required for fair pricing. The usual argument is that investors and analysts are shortsighted, placing too much weight on current profits and dividends. This obliges managers to cut long-term investments. For, if managers invest in projects without an immediate pay-off, their profits and share price fall. As financial markets are myopic, managers should not pursue increase-the-stock price rule because long-term value maximization would be subordinated. If financial markets are indeed myopic, we should expect share price to fall when companies announce increase in capital expenditure. This, in general, does not happen. On the contrary, cuts in capital investments are considered bad news. Perhaps financial markets are not too short-sighted after all. If the markets are not short-sighted, what is the real reason for under investment? Perhaps managerial short-sightedness is the answer. Most executive incentive systems link rewards to short-term profits. If managers are rewarded on the basis of current profits, they would have little incentive to invest for the long run. There is a popular belief that US companies invest too little in intangible assets and capabilities required for competitiveness because of short-termism on the part of managers, shareholders, lenders, and investment managers and the inability of the capital market to deploy capital to most productive uses (Porter 1992).

1.4 Market Efficiency and Price Discovery

News and information reach financial markets every hour of the day. Companies may report higher or lower earnings than what was expected, acquire companies, restructure assets and liabilities, and so on. Investors and market intermediaries try to digest the information and price the share consistent with what they heard and understood. But do they react rationally? The Efficient Market Hypothesis (EMH) states that the price of a stock at any given point in time fully reflects all available information relevant to the value of the stock at that time. Infosys Technologies's (a leading international software developer from India) share, for instance, according to EMH, should fully reflect at all times the prevailing prospects for India, the IT industry, as well as the prospects specific to Infosys. The share price of Infosys should equal its intrinsic value at all times. Is market efficiency a fact? If not, does this invalidate the wealth maximization rule? In other words, is maximization of shareholders wealth an operational concept? If shares are undervalued, the managers of a company, acting in the interest of existing shareholders, will not sell stock cheaply. If the company has exhausted its borrowing capacity, the company may have to forgo profitable projects. Likewise, if shares were overvalued, managers would want to sell shares even when the project is unprofitable, thereby transferring wealth from new shareholders to old shareholders. Ask any chief executive what she/he considers the stock price. Chances are that she/he thinks the stock is under-priced. It is possible that managers may have superior information compared to outside analysts. This does not imply that stock markets do not reward value-maximizing strategies. The difference in opinion between managers and investors is not on whether the company is profitable or not but *how much profitable* and for *how long*. The increase or decrease in share price at the time of annual earnings announcements is not due to the short-sightedness of investors. It is merely an indication of revision of investor expectations. Managers will benefit from interacting with prominent analysts and eliciting their views on the company's stock market performance. Even in emerging markets, analysts do a fairly good job of price discovery. Financial markets may not be efficient at all times. It is enough if they are frequently efficient.

1.5 Types of Capitalism

Broadly, there are two types of capitalism: arm's length system (e.g., U.S, U.K) and relationship-based system (e.g., Germany, Korea). In an arm's length (market-based) Anglo–Saxon system, a financier is protected by explicit contracts as opposed to a relationship-based system, which is largely self-governing; parties honor agreements to maintain their reputation. In market-based system, relationship matters less. In a relationship-based system, the lending bank has a close long-term relationship with the borrower. The lender often belongs to the same group. The *chaebol* in Korea or the *Keiretsu* in Japan exhibits close relationship with their lenders. For long, academicians have argued whether one type of capitalism is better than the other. Until the late 1980s, the East Asian economies were relationship-based systems. The relationship-based system works well when contractability is low and the amount of capital available is low. In other words, relationship-based systems are suitable if legal enforcement and investor protection norms in the country are weak and the amount of capital available relative to opportunities is low. Financiers (banks) in these countries tend to form long-term relationships with business. Over a period of time, many of these countries (e.g., Korea) attracted large amounts of foreign capital to fund opportunities created from opening up of the economy even when the institutional infrastructure was inadequate. The businesses in these countries needed capital, which the foreign investors readily supplied. Korean companies like Daewoo funded much of their investment with debt. The debt ratios of some Korean companies were more than 300%. Most Korean companies had taken on huge amounts of debt to diversify into hi-tech businesses like computers and telecom. Since the investors from Anglo–Saxon, market-based systems do not find extensive contracting and legal enforcement in these countries, they tend to lend short so that they can pull out if there is a problem. When the East Asian financial crisis was triggered due to the depreciation of Thai Baht, Korean investors pulled out, leading to a capital shortage. Relationship-based systems are now under attack for being inefficient and corrupt and everybody is praising the merits of the arm's length system (Rajan and Zingales 1998).

1.6 Security Analysis and Stock Selection

Many fund managers' stock selection process is centered on fundamental security analysis and emphasizes companies that are industry leaders or dominate certain niches. These companies generally have certain competitive advantages or franchises. Fund managers choose a company that earns a superior return on its capital and that they believe has the potential to continue to earn superior returns over many years.

They prefer companies that are strong cash flow generators. Their focus is on companies that produce cash in excess of their capital spending and dividend payouts. This free cash can be utilized proactively on behalf of the shareholders.

Possible applications include acquisitions, share repurchases, and dividends. Fund managers expect management to be skilled with respect to the allocation of the company's capital. They take a close look at the management team, its ethical approach to doing business, as well as a track record. They expect management to display a commitment to the shareholders and own a meaningful long-term holding in their company's shares.

They typically seek to purchase stocks at a significant discount to what they judge to be their underlying, intrinsic value. The efforts to determine underlying intrinsic value are eclectic and generally based on a combination of measures, including current earnings power; cash flow; book value; assets; sum of the parts analysis; merger and acquisition pricing comparables; and other metrics common to the industry.

The most direct way to find out what professional managers do is to ask them. This is what round table discussions and academic surveys accomplish. In a round table discussion conducted by the Columbia University, professional fund managers shared their investment philosophy.

Managers at Lazard Asset Management, for instance, use standard discounted cash flow and other methodologies. They put all investment candidates into three buckets: those companies that have dominant position in their industry; those that are undergoing restructuring; and mispriced securities. These investment buckets are used to construct portfolios of stocks that outperform benchmarks with less volatility.[2]

1.7 Stock Selection Criteria

Investors are of two types: active and passive. Active investors try to analyze companies on the basis of discounted cash flow valuation/real options methodology and time the market. That is, try to pick companies that are undervalued according to some criteria. Passive investors, on the contrary, start with the assumption that the market knows best and mimic either the index or some other investor.

1.8 Benjamin Graham's Approach

Ben Graham, the legendary investor, in his Investments classic, the intelligent investor, recommends that a defensive investor should choose between two approaches (Benjamin 1973): (1) buying a low-cost index fund, which will assure market return with minimal effort, or (2) applying a set of standards to each stock purchase to improve one's odds of beating the market. He recommends the following stock screens:

[2] From Stock Selection to Portfolio Alpha Generation: The Role of Fundamental Analysis, Journal of Applied Corporate Finance, Vol 18 No 1, Winter 2006

1. Adequate size of the enterprise
   Graham's idea here is to exclude small companies, which may be subject to more than average volatility (or illiquidity, or neglect). He does note that there will often be good opportunities in smaller stocks, but this is probably not for the "defensive" investor. In 1973, he recommended not buying stocks with less than US $100 million in sales and $50 million in assets.
2. A sufficiently strong financial condition
   For industrial companies, Graham looked for current assets to be at least twice the current liabilities (current ration > 2). Also, long-term debt should not exceed the net current assets (or "working capital").
3. Earnings stability
   The company must have positive earnings in each of the last 10 years.
4. Dividend record
   The company must have paid dividends without interruption over the previous 20 years.
5. Earnings growth
   The company must have experienced a minimum increase of at least one-third (33%) in per share earnings (EPS) in the past 10 years using 3-year averages at the beginning and end.
6. Moderate price/earnings ratio
   The prevailing stock price should not be more than 15 times average earnings of the past 3 years (historical PE < 15).
7. Moderate ratio of price to assets
   Current price should not be more than 1.5 times book value. However, a PE < 15 could justify a correspondingly higher multiplier of assets. As a rule of thumb, Graham suggests that the product of the PE and (ratio of price to book) should be less than or equal to 22.5 (which again corresponds to a stock price that is 15 times earnings and 1.5 times book value).

These screens are designed to eliminate most stocks from an investor's radar screen by excluding companies that are (1) too small, (2) in relatively weak financial condition, (3) with a deficit stigma in their 10-year record, and (4) not having a long history of continuous dividends. Obviously, looking at 10- to 20-year track record is easier in the mature markets of the United States and Europe, but probably too restrictive in young markets of Asia. Nonetheless, the concept remains sound.

1.9 Stock Selection Based on Mutual Fund Holdings

Academics have investigated whether individual investors should consider the weightings mutual fund managers place on the stocks held in their funds when making stock selection decisions (Weigand et al., 1973). Specifically, they compare the performance of the stocks that are most heavily weighted in mutual funds vs. the stocks that are most lightly weighted. These studies find that the heavily weighted stocks in mutual funds perform no better than, and sometimes significantly underperform, the most lightly weighted stocks. These results contradict the idea that individual investors can earn excess returns by following the implicit stock selection picks of mutual fund managers, particularly, short-term and momentum investors who trade large-cap stocks. These findings rather suggest that individual investors should be wary of investing in stocks that are the top holdings in general equity mutual funds.

1.10 Timing the Market: Technical Analysis[3]

The methods used to analyze securities and make investment decisions fall into two very broad categories: fundamental analysis and technical analysis. Fundamental analysis involves analyzing the characteristics of a company to estimate its value. Technical analysis takes a completely different approach; it does not care one bit about the "value" of a company or a commodity. Technicians (sometimes called chartists) are only interested in the price movements in the market. Despite all the fancy and exotic tools it employs, technical analysis really just studies supply and demand in a market in an attempt to determine what direction, or trend, will continue in the future. In other words, technical analysis attempts to understand the emotions in the market by studying the market itself, as opposed to its components. If you understand the benefits and limitations of technical analysis, it can give you a new set of tools or skills that will enable you to be a better trader or investor.

1.11 Concluding Comments

The goal of security analysis is to generate abnormal returns by identifying undervalued securities. In the chapters that follow we describe the following:

- The design and functioning of stock markets around the world
- The prominent theories of asset pricing
- The process of financial statement analysis to identify investment candidates and forecast future financial performance
- Models of valuation
- Fixed income instruments, their valuation, and derivatives
- The behavioral approach to investment management

Because of the size of financial markets, investment management attracts a lot of attention from both the academia and the industry. It would be impractical to cover every major piece of research in a book. Consequently, we have provided a small list of suggested reading at the end of each chapter for the benefit of interested readers.

[3] Technical analysis is a vast subject in itself. Interested Readers may refer to Achelis, Steven, Technical Analysis from A to Z, Equis International, 2003

1.12 End of the Chapter Questions

1. What is the role played by financial markets?
2. Explain market efficiency and short-termism.
3. What are the two types of capitalism? Explain.
4. Explain Benjamin Graham's approach to stock selection.

References

Benjamin G (1973) The intelligent investor. Harper Collins, India

Porter ME (1992) Capital disadvantage: America's failing capital investment system. Harvard Bus Rev 70:65–82

Rajan R, Zingales L (1998) Which capitalism? Lessons from the east asian crisis. J Appl Corp Finance 11(3):40–48

Weigand, RA, Belden S, Zwirlein T (2004) Stock selection based on mutual fund holdings: Evidence from large-cap funds. Financial Services Review, Summer

Chapter 2
Introduction to Market Microstructure

Chandrasekhar Krishnamurti

2.1 Chapter Introduction and Objectives

A stock exchange or bourse is a corporation or a mutual organization that provides trading facilities for traders to trade stocks and other securities. The top 12 exchanges have a combined market capitalization running to trillions of dollars. Obviously, investors, corporations, and academics are interested in the design and the functioning of stock markets. In this chapter, we provide an overview of type and design of markets, and price formation and price discovery.

This chapter has the following objectives:

- Define market microstructure
- Discuss market structure and design issues
- Highlight how some of the top exchanges like the New York Stock Exchange (NYSE), NASDAQ, Tokyo Stock Exchange, and London Stock Exchange operate

2.2 What is Market Microstructure?

A common definition of market microstructure is "It is the study of the trading mechanisms used for financial securities." Professor Maureen O'Hara of Cornell University, an authority on market microstructure, describes market microstructure as "the study of the process and outcomes of exchanging assets under a specific set of rules."

C. Krishnamurti
AUT University College of Business, WF Building, Wellesley Campus, 42 Wakefield Street, Auckland 1010, New Zealand
e-mail: Chandrasekhar.krishnamurti@aut.ac.nz

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_2,

National Bureau of Economic Research (NBER) defines market microstructure as a field of study that is devoted to theoretical, empirical, and experimental research on the economics of security markets. It includes the role of information in the price discovery process, the definition, measurement and control of liquidity, and transaction costs and their implication for efficiency, welfare, and regulation of alternate trading mechanisms and market structures.

It appears at a superficial level that market microstructure is about designing a superior stock exchange. But market microstructure is much more than that. Market microstructure has broader interest among financial economists, since it has implications for asset pricing, international finance, and corporate finance. A basic premise of market microstructure theory is that asset prices need not reflect full information expectations value due to a variety of frictions. Thus, market microstructure is related to the field of investments, which is concerned with the equilibrium value of financial assets. Market microstructure is also linked to traditional corporate finance, since difference between price and value has the potential to affect financing and capital structure decisions taken by managers. The relationship between market microstructure and other areas of finance is relatively new and is continuing to evolve.

In this chapter, we will take an information economics perspective of market microstructure and summarize current research in the following key areas:

- Market structure and design issues
- Price formation and price discovery
- Information and disclosure
- Market microstructure interface with other areas of finance

2.2.1 Market Structure and Design Issues

In this section, we describe the salient features of the different trading systems that operate in the world today. This would facilitate a critical discussion on market structure and design issues that are critical to an understanding of the price formation process in financial markets. We begin by explaining the various prices, orders, and trading priority rules that are commonly used in market microstructure parlance.

Prices: An ask quotation is an offer to sell at a specific price, the *ask price.* It is also sometimes called the ask price. A bid quotation is an offer to buy at a specific price, the *bid price*. The price at which a transaction occurs is denoted as the *transaction price*. Transaction prices usually occur at previously announced bid or ask quotations but could also occur at a price that is in between the bid and the ask price.

Orders: A public trader gives an order to a broker who acting as the trader's agent directs the order to a market where the trade may be arranged. The trader must specify the exact number of shares to be bought or sold. In addition, the trading instruction should also include the price at which the trade is to be made. Based on how the trader specifies the price of trade, orders may be classified into either *market orders* or *limit orders*.

A *market order* to buy or sell is to be executed at the best price established on the market at a given point in time. For a market order seller (buyer), the best price is the highest (lowest) bid (ask) posted by a potential buyer (seller). A limit buy (sell) order specifies the maximum (minimum) price at which the trader will buy (sell). Price limits for buyers (sellers) are normally placed at prices below (above) the current price at which shares can be bought (sold). Limit orders that do not execute when they are placed remain active on the book until they execute, are withdrawn, or expire. Day orders are automatically cancelled at the end of the trading day. Good till cancelled (GTC) orders remain in the book until they are cancelled.

Market order traders face uncertainty regarding the exact price at which they will transact, but unlike limit order traders they are assured of transacting.

Trading Priority Rules: *The Price Priority Rule:* With *price priority*, buyers posting higher bids have priority over buyers posting lower bids and sellers posting lower asks have priority over sellers posting higher asks. In addition to price priority, a secondary trading priority rule is often established to specify the sequence to be followed for orders submitted at the same price. With *time priority*, the first order placed is the first to execute. Sometimes a size priority rule is used wherein the largest order is the first to execute. A third alternative is pro rata execution of all orders tied at the same price. Sometimes a class of orders such as public traders is given priority over market professionals.

2.2.1.1 Taxonomy of Trading Systems

Trading systems can be classified on the basis of participants. Using this classification, we have (a) Dealer Markets and (b) Agency Markets. A broker is a trader's agent. A broker does not herself participate in the market but merely matches the order with a counterparty on the other side of the transaction. A dealer on the contrary participates in a trade as a principal.

Dealer Markets

As a principal, a dealer satisfies a public order by buying for her own inventory or by selling from her inventory. In a dealer market, public traders do not trade directly with each other but with a dealer who serves as intermediary. The over-the-counter (OTC) market in the United States is an example of a dealer market.

Agency Markets

In an agency market, public orders are directed to a broker's broker who matches them with other public orders. Market professionals do not participate in trading in an agency market. The Tokyo Stock Exchange (TSE) is an example of a pure agency market. The TSE is established by the limit order book. Floor officials called *Saitoris* oversee the books and are not allowed to participate in trades as a principal. They only maintain the limit order book and monitor trading activity.

Trading systems can also be classified on the basis of when the participants are allowed to trade. On the basis of this categorization, we have (a) Continuous Markets and (b) Call Markets.

Continuous Markets: A continuous market allows trades to be made at any time during the trading day. In the United States, both the New York Stock Exchange (NYSE) and National Association of Securities Dealers Automated Quotation System (NASDAQ) are continuous trading systems. Both dealer and agency markets can be continuous. In a dealer market, the dealer making the market in a given stock is obligated to maintain a continuous two-sided market for the stock. In an agency market, a continuous two-sided market is maintained by public limit orders that have been entered on the limit order book and/or by floor traders in the crowd.

In a continuous market, traders can observe bid and ask quotations, transaction prices, trading volume during the trading day. This enables them to assess the market conditions before placing their orders. Furthermore, the posting of quotes in a continuous market gives traders the option of placing market orders and ensuring execution of their trades. If a continuous market is orderly, traders have an indication of the prices at which their orders will most likely execute. However, market order trades do not have complete certainty due to limited availability of information and lack of dissemination of information in a timely manner.

Call Markets: In a call market, orders are batched for simultaneous execution at points in time when the market is "called." Call markets are typically called once or twice during the trading day. Call markets are primarily agency markets and not dealer markets. All order that have accumulated over a period of time are batched and executed simultaneously at the same price. Public orders interact directly with other public orders in the batching process and therefore do not need a dealer to participate as an intermediary. Trading in a call market can be done either by written auction or by verbal auction. On the Paris Bourse, verbal auction is used for the most actively traded issues while a written auction is used for smaller issues. Verbal auctions tend to be more expensive but are more desirable for floor traders who are able to adjust their orders in response to dynamic market conditions.

Traders can submit both limit and market orders in call markets. Market orders transact at whatever prices are established at the calls. In comparison to continuous market's market order, traders do not have an indication of prices at which their trades are likely to be transacted. In fact, they are not even assured of a transaction. Since call markets normally include a provision that limits the maximum allowable difference from the previously established call price.

An auctioneer (an exchange official) is at the centre of the call. All orders for an issue are directed to the auctioneer when the stock is called. The auctioneer arrives at a clearing price that most closely matches the aggregate number of shares offered for sale with those sought for purchase. Then, all market orders to buy and sell, all limit orders to buy at the clearing price or higher, and all limit orders to sell at the clearing price or lower are executed. In a call market, all the buyers and sellers pay or receive the same price – the clearing price.

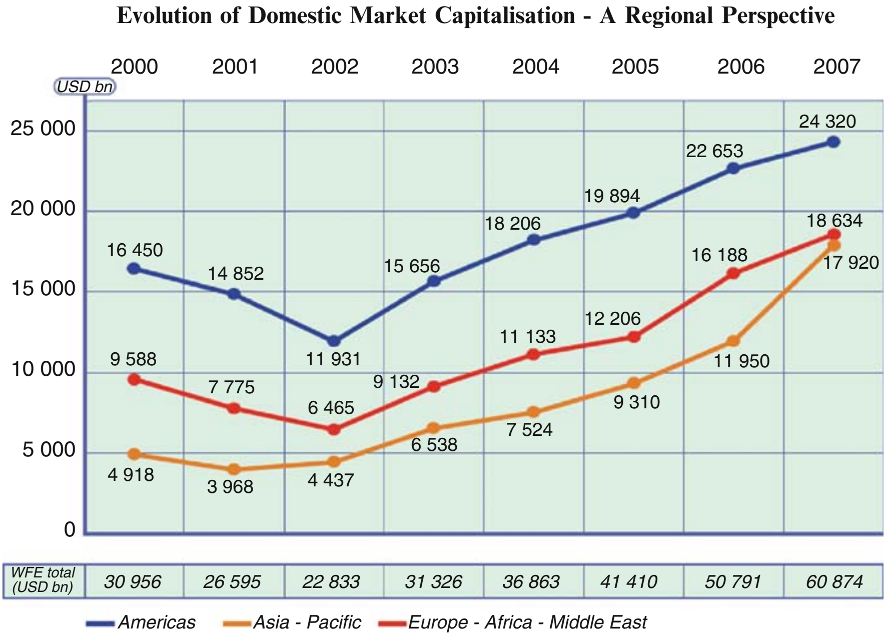
The price priority rule is strictly adhered to in call market trading. A secondary priority is also required to deal with issues such as discrete order size and minimum allowable price changes. The opening process at stock exchanges like NYSE and Amex follow a call market system at the opening of the market each day. Exhibits 2.1–2.3 provide the "league tables" of stock exchanges.

Exhibit 2.1 World's largest stock exchanges based on domestic equity market capitalization

Exchange	USD bn end 2007	USD bn end 2006	% change in USD	% change in local currency
NYSE group	15,651	15,421	1.50	1.50
Tokyo stock exchange	4,331	4,614	−6.10	−12
Euronext	4,223	3,713	13.70	2.60
Nasdaq stock market	4,014	3,865	3.80	3.80
London stock exchange	3,852	3,794	1.50	−0.20
Shanghai stock exchange	3,694	918	302.70	276.80
Hong Kong exchanges	2,654	1,715	54.80	55.20
TSX group	2,187	1,701	28.60	9
Deutsche Borse	2,105	1,638	28.60	15.90
Bombay stock exchange	1,819	819	122.10	97.80
BME Spanish exchange	1,799	1,323	361.10	22.70
National stock exchange of India	1,660	774	114.50	91

Source: World Federation of Exchanges. http://www.world-exchanges.org

Exhibit 2.2 Evolution of domestic market capitalization – a regional perspective



Source: World Federation of Exchanges. http://www.world-exchanges.org

Exhibit 2.3 Largest exchanges by total value of share trading

Exchange	USD bn end 2007	USD bn end 2006	% change in USD	% change in local currency
NYSE Group	29,910	21,789	37.3	37.3
Nasdaq Stock Market	15,320	11,807	29.7	29.7
London Stock Exchange	10,333	7,571	36.5	26.1
Tokyo Stock Exchange	6,476	5,823	11.2	12.2
Euronext	5,640	3,853	46.4	34.5
Deutsche Borse	4,325	2,737	58	45.2
Shanghai Stock Exchange	4,070	736	452.7	426.6
BME Spanish exchange	2,970	1,934	53.6	41.1
Borsa Italiana	2,312	1,591	45.3	33.6
Hong Kong Exchanges	2,137	832	156.7	157.8
Shenzhen Stock Exchange	2,103	423	397.6	374.1
Korea Exchange	2,006	1,342	49.5	46

Source: World Federation of Exchanges. http://www.world-exchanges.org

The New York Stock Exchange

The New York Stock Exchange (NYSE) is the world's largest and most liquid cash equities market in the world. NYSE provides a reliable, orderly, liquid, and efficient market place for investors to buy and sell listed common stocks and other securities. As of 30 April 2008, NYSE's domestic market capitalization exceeded US $ 14 trillion. More than 2,300 companies are listed on NYSE, including over 400 foreign companies. On an average trading day, about 2.5 billion shares are traded valued at over $ 121 billion.

NYSE blends various aspects of electronic trading and traditional open outcry, auction market trading. To trade on the trading floor of NYSE, an exchange-issued trading license is required. Only qualified and approved NYSE broker–dealer entities may acquire and hold licenses. The holders of these licenses are either floor brokers or specialists.

Floor brokers represent public orders to buy or sell shares and wish to get the best price for their customers. There are two types of floor brokers on the trading floor: house brokers and independent brokers. House brokers are engaged by brokerage firms that hold accounts for public investors. These market professionals buy and sell securities as an agent for their customers. The majority of independent brokers are "direct access" brokers who deal with institutional investors at low commission rates.

Each stock listed on the NYSE is allocated to a *specialist*, a market professional who acts as a contact point between brokers with buy orders and those with sell orders. Specialists act as auctioneers in the specific stocks they are allocated to trade at a designated location, called a trading post. All buying and selling of a given stock occurs at that location. The specialists are aided by highly sophisticated technology to facilitate their duty to provide a continuous liquid market. NYSE has the capacity to trade up to 10 billion shares per day. The orders are electronically directed to the trading posts, booths, and hand-held computers on the trading floor in one of the following four ways:

- SuperDOT
- BBSS
- NYSE e-Broker
- NYSE Direct +

SuperDOT (Designated Order Turnaround System): It is an electronic order routing system to direct buy and sell orders to the specialist's workstation at the trading post. SuperDOT handles most of the smaller orders and accounts for more than 95% of all orders.

BBSS (Broker Booth Support System): It is a highly sophisticated computer system that is used to receive orders on the trading floor. The system is linked to the specialist's post and the broker's handheld computer.

NYSE e-Broker: It is a wireless hand-held tool that enables floor brokers to submit and manage quotes and orders. It is also used to track executions and transmit information between the brokers and the customers.

NYSE Direct+: It is a high speed electronic communication system between NYSE member firms and the exchange. It enables immediate execution of customer orders.

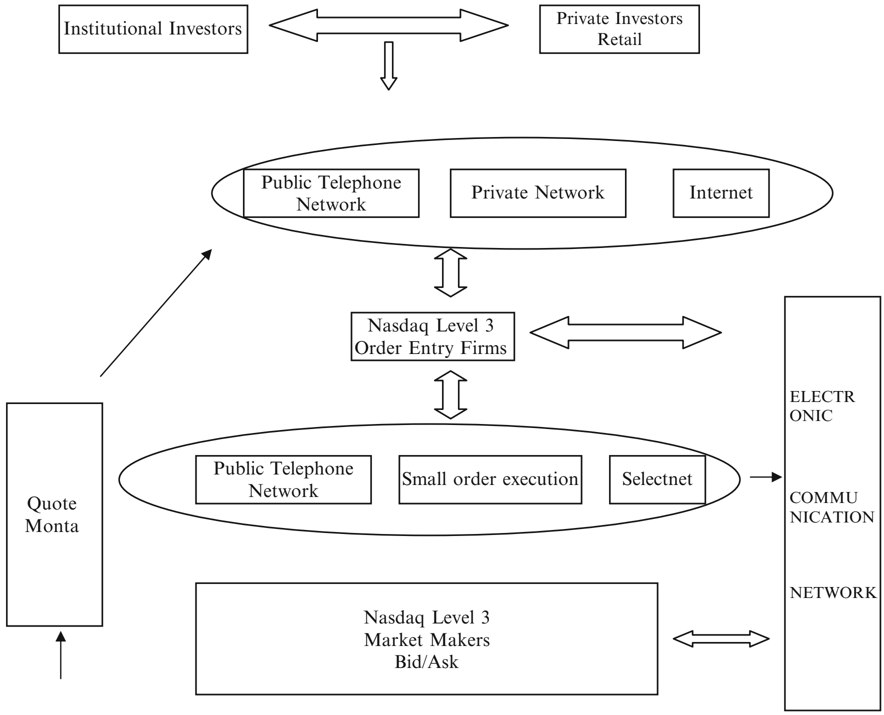
National Association of Securities Dealers Automated Quotation System

NASDAQ is the acronym of the National Association of Securities Dealers Automated Quotation System and has been designed as a dealer market. NASDAQ was created with the intention of enhancing the efficiency of the OTC markets for stocks. In essence, NASDAQ is a telecommunication network linking thousands of geographically dispersed market participants. A pictorial overview of the NASDAQ system is provided in Exhibit 2.4.

NASDAQ has been designed as a dealer market. By providing quotes and therefore liquidity, market makers are the principal players in the NASDAQ market structure. They are independent dealers who actively compete for investor orders by displaying quotes representing their buy and sell interest in addition to customer limit orders. Every market maker has equal access to NASDAQ's trading system, which broadcasts their quotations simultaneously to all market participants. By standing ready to buy and sell shares of a company's stock, market makers provide immediate liquidity to NASDAQ-listed companies. Currently, there are more than 500 market making firms that provide liquidity support for NASDAQ-listed stocks.

NASDAQ market makers are charged with three major tasks. First, they are required to disclose their buy and sell intentions by displaying two-sided quotes in all stocks in which they choose to make a market. Second, they have to comply with the Securities and Exchange Commission's Order Handling Rules (SEC) with respect to displaying quotes and orders. Third, they are obliged to honour their quotes and to report trading in a timely manner. Failure to abide by the rules can lead to disciplinary action.

Exhibit 2.4 The National Association of Securities Dealers Automated Quotation System (*NASDAQ*)



There are four types of market making firms: (1) Retail market making firms own a retail brokerage network that serve individual investors. The order flow from this segment facilitates liquidity provision for the company's stock; (2) Institutional market making firms specialize in executing large block orders for pension funds, mutual funds, insurance companies, and asset management companies, among others; (3) Regional market making firms focus on both companies and retail investors of a particular region. The regional market maker gives companies and retail investors the benefit of expert in-depth knowledge of stocks of a particular area of the country, providing more extensive coverage than might be available elsewhere; (4) Wholesale market making firms provide liquidity services for institutional clients as well as for other broker–dealers who are not registered market makers in a stock. They provide liquidity for a company's stock by being an important source of trade facilitation for retail, institutional, and regional firms.

NASDAQ contains an automatic execution system for orders of up to 1,000 shares called the Small Order Execution System (SOES). SOES guarantees immediate automatic execution at the best possible bid or offer price available in NASDAQ for all eligible orders even under turbulent market conditions. When an investor places a sell order, SOES would direct the order to the market maker currently offering the best bid price and ensure execution automatically at the best displayed price. NASDAQ trading information is currently simultaneously broadcasted to more than 500,000 computer terminals worldwide. This allows all NASDAQ participants' equal access to market information. All market makers in the NASDAQ National Market have to mandatorily participate in the SOES.

Another way to place orders on NASDAQ is by using the SelectNet, which works as an email system to enable market makers to negotiate prices among themselves. Through SelectNet, a market maker can either send a stock order to another market maker making a market in that particular stock or broadcast the order to all market makers through NASDAQ's electronic marketplace. A screen-based negotiation feature facilitates market makers to accept, reject, or make counter offers. After the parties have agreed on the terms of a trade, SelectNet locks-in the trade details for clearance and settlement and simultaneously reports the trade. SelectNet is not a matching service. It is merely a tool for routing information.

Tokyo Stock Exchange

Trading on the Tokyo Stock Exchange (TSE) is organized very differently from that prevalent in the NYSE and NASDAQ. There is no designated liquidity provider in TSE. Liquidity on TSE is provided by the combination of a limit order and a mechanism for slowing down the trade process during periods of order imbalances. Liquidity is organized by the *Saitori* on the TSE who is the counterpart to the specialist on the NYSE. It is the responsibility of the *Saitori* to maintain the public limit order book and to govern the trade process. The *Saitoris* do not trade for their own account. They match market and limit orders, issue warning quotes when trade execution results in price changes that exceed exchange-prescribed maximum variation limits. Trading is halted when order execution would result in price changes that exceed exchange mandated daily price limits. Daily price limits and maximum price variation limits depend on the price level of the stock and are shown in Exhibits 2.5 and 2.6.

The daily price limits for most stocks are quite large in percentage terms and are therefore rarely hit. On the contrary, the maximum price variation limits that are allowed between the trades are much smaller for most price ranges and thus this barrier is hit much more frequently.

The procedure used by *Saitoris* to slow down trade and attract liquidity is depicted in the diagram in Exhibit 2.7. It describes possible events that occur following the arrival of a market order.

Sequence 1 indicates that a market order is completely filled at the prevailing quote and a regular trade occurs. Sequence 2 denotes that a market order walks up or down a limit order book, that is, parts of the trade are executed at different prices. The *Saitori* issues *chui kehai* (warning quotes) as each new price is hit but no trading halt occurs. Sequence 3 shows the sequence of events following when the price change on entire order execution exceeds maximum allowable price variation. In this case, the *Saitori* only allows partial execution of a market order. The *Saitori* then issues a *chui kehai* at the maximum price variation and halts the trade. In sequence 4, we have a situation where the *Saitori* prevents a market order from

Exhibit 2.5 Maximum price variation limits between trades on the Tokyo Stock Exchange (TSE)

Last special quote	Price level (¥)	Price variation (¥)
Less than	500	±5
Less than	1,000	10
Less than	1,500	20
Less than	2,000	30
Less than	3,000	40
Less than	5,000	50
Less than	10,000	100
Less than	20,000	200
Less than	30,000	300
Less than	50,000	400
Less than	70,000	500
Less than	100,000	1,000
Less than	150,000	2,000
Less than	200,000	3,000
Less than	2 million	30,000
Less than	3 million	40,000
Less than	5 million	50,000
Less than	10 million	100,000
Less than	15 million	200,000
Less than	20 million	300,000
Less than	30 million	400,000
Less than	50 million	500,000
50 million or more		1 million

Source: TSE Fact Book 2003

fully executing, since the required price change would exceed the maximum price variation, and during the halt another market order on the same side arrives from a different brokerage house. The arrival of the second order on the same side of the market from another exchange member is taken as an indication of a possible change in equilibrium price. Now the *Saitori* issues a *tokubetsu kehai* (special quote), continues the trading halt, and gradually revises the special quote typically every 5 min in the absence of additional orders. The *Saitori* in effect publicizes this change in equilibrium price to the market through this measured revision of the special quote. When the special quote reaches the current best quote, the pending order will be fully executed under the assumption that the resulting price change would not exceed the daily price limit.

London Stock Exchange

London Stock Exchange (LSE) is one of the oldest exchanges in the world. It is more than 300 years old. They initially started operations circa 1698 in Jonathan's Coffee House in Change Alley in London. The origins of capital market in London dates

Exhibit 2.6 Tokyo Stock Exchange (TSE) daily price limits daily price limit is based on previous day's closing price or special quote

	Previous Day's Closing Price/Special Quote (yen)	Daily Price Limits (yen)
Less than	100	±30
Less than	200	50
Less than	500	80
Less than	1,000	100
Less than	1,500	200
Less than	2,000	300
Less than	3,000	400
Less than	5,000	500
Less than	10,000	1,000
Less than	20,000	2,000
Less than	30,000	3,000
Less than	50,000	4,000
Less than	70,000	5,000
Less than	100,000	10,000
Less than	150,000	20,000
Less than	200,000	30,000
Less than	300,000	40,000
Less than	500,000	50,000
Less than	1 million	100,000
Less than	1.5 million	200,000
Less than	2 million	300,000
Less than	3 million	400,000
Less than	5 million	500,000
Less than	10 million	1 million
Less than	15 million	2 million
Less than	20 million	3 million
Less than	30 million	4 million
Less than	50 million	5 million
50 million or more		10 million

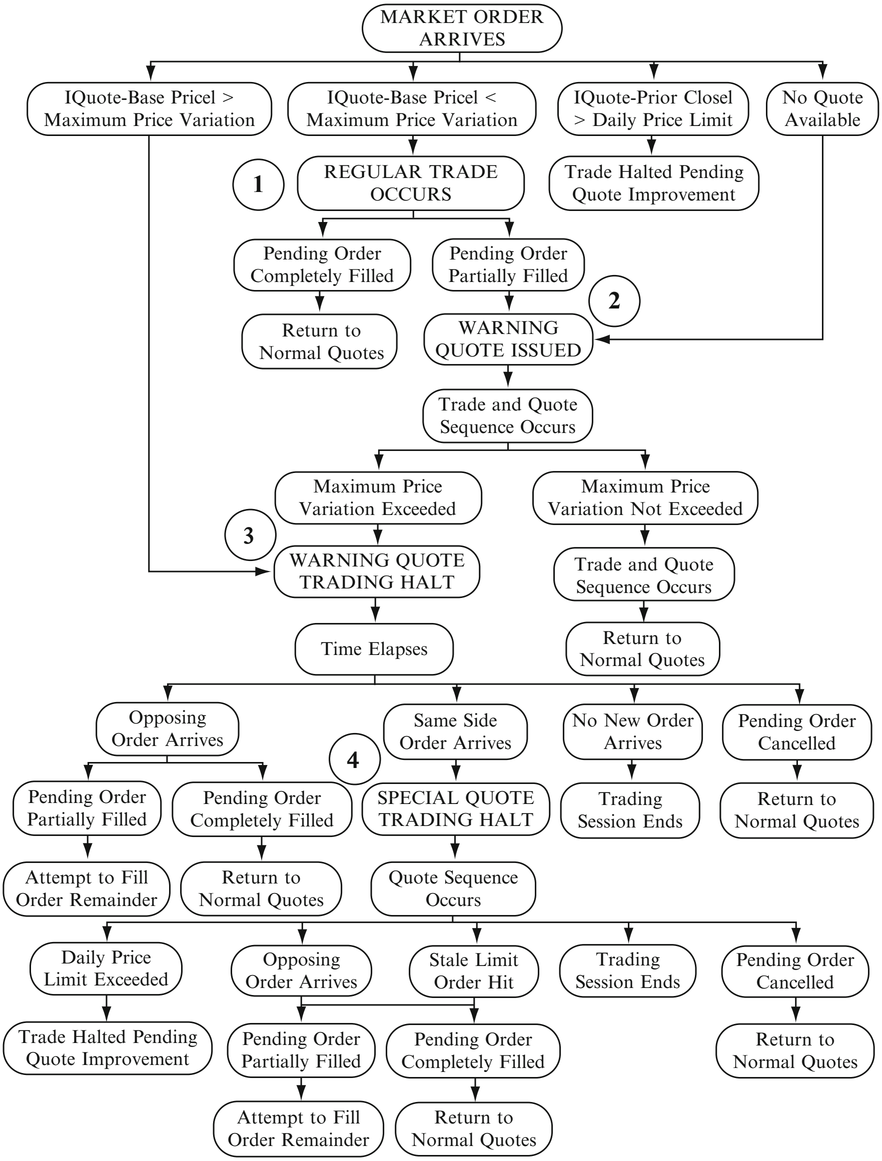
Source: TSE Fact Book 2003

back to 1593 when the first joint stock company called "Muscovy" was formed by 240 investors who subscribed to one share each worth £ 25 for the specific purpose of provisioning the search to discover a north-east passage to the mysterious far-east.

Capital markets in London have come a long way, since then facilitating the financing of the industrial and the current service economies of the globe. LSE went through a major deregulation of the market known popularly as the "big bang." The major changes characterizing the big bang are listed below:

- Ownership of membership firms by an outside corporation is allowed
- All firms become brokers/dealers able to operate in a dual capacity
- Individual members cease to have voting rights

Exhibit 2.7 Possible sequence of events following the arrival of market order



Source: Lehmann and Modest (1994)

- Age-old trading floor was replaced by electronic screens and negotiations over the phone
- Fixed commissions were abolished
- The Exchange becomes a public limited company

There are three major market segments on the LSE:

- The main market
- Alternative investment market (AIM)
- Market for international securities

A domestic stock may trade in one of the three different trading systems: the SETS, the SEAQ, or the SEATS Plus. SETS stands for stock exchange electronic trading system and is the LSE's blue chip market. SETS is fully electronic, order driven, and an anonymous market with no market makers. The SEAQ is a quote-driven market and stands for stock exchange automated quotation system. SEAQ is LSE's market for medium-size stocks and the most liquid AIM stocks. The market is based on two-sided continuous market maker quotes.

Finally, the SEATS Plus (Stock Exchange Alternate Trading Services) is an electronic market. It combines an order-driven market with a quote-driven market and offers the benefits of an order-driven system with guaranteed liquidity provided by market makers. This service is utilized by small, less, liquid stocks and all AIM securities.

The major objectives of a stock exchange are to provide liquidity and price discovery. We elaborate on liquidity below and discuss price formation in the next subsection.

Liquidity is not unlike beauty, in that it easier to recognize but far more difficult to define or measure. To compound the difficulty, there are several dimensions of liquidity. An asset is considered to be liquid if it can be converted to cash with ease. Ease of conversion can be measured either by the time taken to trade an asset for cash or by the cost of trading an asset for cash immediately. In market microstructure literature, more attention is paid to the cost of immediacy as opposed to the time required to trade. Immediacy costs can be further broken down into explicit and implicit costs. Brokerage commissions and taxes constitute explicit costs of immediacy. Implicit costs are hidden costs. They are also execution costs and include the following:

- Rounding of prices
- Bid–ask spreads
- Market Impact Effects
- Imperfections in the Price Determination Process

We discuss these factors below.

Rounding of Prices: Bid–Ask Spread – Bid–ask spread exists due to the existence of an order imbalance in real-time. Buy and sell orders do not arrive simultaneously to clear at the existing equilibrium price. An explicit or implicit market maker provides a two-way quote – a buying price and a selling price with associated quantities for immediate execution. The bid–ask spread is then the compensation for providing immediacy. Market impact costs are due to large orders moving the transaction prices albeit temporarily. Real-world securities markets are characterized by several imperfections.

A liquid market is characterized by breadth, depth, and resiliency. Breadth refers to the existence of orders in substantial volume. Depth is the existence of orders on both sides of the market near the current equilibrium price. Resiliency is the responsiveness of new orders to price changes caused by temporary order imbalances. A market is not resilient when the order flow does not quickly adjust to errors in price discovery.

2.2.2 Price Formation and Price Discovery

Markets have two principal functions according to O'Hara (2003). They are provision of liquidity and the facilitation of price discovery. Clearly asset prices evolve in markets. This evolution is influenced by the nature of players in the market and the trading system in vogue. Traditional market microstructure literature has categorized traders based on their information system – informed traders and uninformed traders. Informed traders have an informational edge regarding the stocks that other traders do not possess. They exploit this informational advantage while trading with others. The uninformed investors trade for noninformational reasons. In some cases, they are termed as "noise traders," since their trade is based on their beliefs and sentiments that are not grounded on fundamental information. Information is revealed to the market through the trading activities of informed traders.

To profit fully from their informational superiority, informed investors have incentives to slow down the rate at which their trading influences prices. Sometimes, they engage in stealth trading as shown by Chakravarty (2001), using audit trail data for a sample of NYSE firms that medium-size trades are associated with a disproportionately large cumulative stock price change relative to their proportion of all trades and volume. This result is consistent with the predictions of stealth-trading hypothesis attributed to Barclay and Warner (1993). In that paper, they posit that informed investors use medium-size trades rather than large traders to prevent information from being too quickly impounded into stock prices. Chakravarty (2001) finds that medium-size trades are trades initiated by institutions that account for this disproportionately large cumulative price impact. His findings are in conformity with street lore that institutions are informed traders.

2.2.3 Information and Disclosure

There are many informational issues surrounding market microstructure. These include information dissemination and disclosure. Madhavan (2000) defines market transparency as the ability of market participants to observe information about the trading process. Information in this context refers to knowledge about prices, quotes, volumes, sources of order flow, and the identities of market participants.

Issues of transparency have been vital to some recent policy debates. For instance, the issue of delayed reporting of large trades has been highly controversial and continues to be an issue as stock exchanges with different reporting rules form trading linkages. A directly related issue concerns the consequences of differences in trade disclosure across markets. These differences may induce order flow migration, and therefore affect liquidity and the cost of trading.

Transparency constitutes a major factor in debates over floor versus electronic systems. Floor systems such as the NYSE typically do not display customer limit orders unless they represent the best quote. In contrast, electronic limit order book systems such as the Toronto Stock Exchange Computer Assisted Trading System (CATS) and the Paris Bourse *Cotation Assistee en Continu* (CAC) system publicize not only the current quotes but also information on limit orders away from the best quotes. In general, the trend around the world has been towards greater transparency.

The practical significance of market transparency has given rise to a large theoretical and empirical literature. In particular, several researchers have studied the consequence of disclosing information about the *identity* of traders or their *motives* for trading. These issues arise in many different situations such as the following:

- Post-trade transparency and reporting;
- Pre-disclosure of intentions to trade such as sunshine trading or the revelation of order imbalances at the open or during a trading halt;
- Dual-capacity trading, where brokers can also act as dealers;
- Front-running, where brokers trade ahead of customer orders;
- Upstairs and off exchange trading;
- The role of hidden limit orders in automated trading systems;
- Counterparty trade disclosure; and
- The choice of floor-based or automated trading systems

2.2.4 Market Microstructure Interface with Other Areas of Finance

A popular measure of liquidity is the bid–ask spread which is the difference between the bid and the ask price quoted by a dealer who makes a market in a stock. The bid–ask spread may be viewed as the price required by the dealer for providing immediate execution of orders. Amihud and Mendelson (1986) examine the relationship between bid–ask spread and stock returns. If investors assess the value of a stock based on their returns net of trading costs, then they should demand a higher rate of return for high spread stocks so as to compensate them for higher trading costs. Thus, investment decisions should incorporate liquidity considerations in addition to risk. While an investor can reduce the risk by holding a diversified portfolio, the cost of illiquidity cannot be diversified away.

Besides required rate of return, liquidity also affects the holding period of a stock. The cost due to the bid–ask spread has to be borne by the investor only once over the holding period. A premium is paid when the stock is purchased and a price concession is made at sale. A longer holding period effectively reduces the amortized transaction cost per unit of time. The larger the holding period of an investor, the lower the extra return required compensating for the bid–ask spread. Thus, stocks with high bid–ask spread will be held by investors with longer holding periods. Conversely, short-term investors should hold low-spread securities.

Amihud and Mendelson (1986) show empirically that security returns reflect the percentage bid–ask spreads. Observed gross returns tend to increase with spread. By their estimates, the monthly excess return of a stock with a 1.5% spread is 0.45% greater than that of a stock with a 0.5% spread. These results have several implications for investment management. First, low liquidity investments are required to produce higher returns for the holders. Real estate and stocks of small firms typically have lower liquidity and therefore produce higher returns. Second, portfolio manager are advised to pay attention to investment horizons of their clients. While a client with a longer holding period is able to withstand the burden of some illiquid assets in her portfolio, other investors with shorter horizons should be directed to hold low-spread securities.

Amihud and Mendelson's framework points out to the benefits of liquidity increasing investments. As a direct consequence of liquidity improvements via lower spreads, the value of a stock should increase. This effectively decreases the cost of capital of the firm. One such move could be to switch the listing of the stock to a more liquid trading environment. Amihud et al. (1997) document large changes in stock prices of companies moving to a more liquid trading system on the Tel Aviv stock exchange.

The going public decision is one such project. The cost benefit analysis of the project is given by

$$C_0 + \frac{c}{R_1} < \frac{E}{R_1} - \frac{E}{R}, \tag{2.1}$$

where C_0 is the initial cost of the public offering, c is the recurring cost associated with public ownership, E is the perpetual cash flow generated by the firm, R is its initial cost of capital and R_1 the cost of capital subsequent to the firm going public. This equation can be approximated as follows:

$$\mathrm{C}_0 + \frac{c}{R_1} < \frac{E}{R} . \frac{\Delta R}{R}, \tag{2.2}$$

where $(\Delta R/R)$ is the relative reduction in the required rate of return.

Amihud and Mendelson (1988) discuss a number of implications of this model. First, a given change in liquidity has a greater effect on the cost of capital when liquidity is already high than when it is low. Thus, it may be more beneficial for forms which are already highly liquid to invest further in increasing the liquidity. Second, a given investment in a liquidity increasing project might provide a greater reduction in the cost of capital and a greater gain for low liquid firms. Third, the benefits of increased liquidity are proportional to the initial value of the firm. Thus, we should expect larger firms to benefit more and therefore to invest more in liquidity enhancing projects as compared to small firms. Finally, for some stocks decreasing liquidity rather than increasing it will be beneficial to the firm when the left hand side of (2) is greater than the right. This implies that the cost of increasing liquidity exceeds the potential benefits. Bharath and Dittmar (2007) provide empirical evidence by showing that low liquidity firms are more likely go private subsequent to their going public, ceteris paribus.

2.3 Concluding Comments

In this chapter, we provided an overview of market microstructure – one of the branches of financial economics. We discussed the organization of major stock exchanges of the world and the process of price discovery. Market microstructure is of special interest to practitioners because of the rapid transformation of the market environment by technology, regulation and globalization. We discussed the practical applications with a focus on market structure, transparency and applications to other areas of finance. The next chapter deals with the regulation of financial markets and services.

2.4 End of the Chapter Exercises

1. What is market microstructure?
2. Describe the different types of trading systems.
3. Compare and contrast how the major stock exchanges are organized.

References

Amihud Y, Mendelson H (1986) Asset pricing and the bid–ask spread. J Financ Econ 17:223–249

Amihud Y, Mendelson H (1988) Liquidity and asset prices: financial management implications. Financ Manag 17:5–15

Amihud Y, Mendelson H, Lauterbach B (1997) Market microstructure and securities values: evidence from the tel aviv stock exchange. J Financ Econ 45(3):365–390

Bharath S, Dittmar A (2007) To be or not to be (public). Working Paper, University of Michigan Ross School of Business

Barclay M, Warner J (1993) Stealth trading and volatility: which trades move prices? J Financ Econ 34:281–305

Chakravarty S (2001) Stealth trading: which traders' trades move stock prices? J Financ Econ 61:289–307

Ellis K, Michaely R, O'Hara M (2000) When the underwriter is the market maker: an examination of trading in the IPO aftermarket. J Finance 55(3):1039–1074

Lehmann, B. M. and D. M. Modest (1994) Trading and liquidity on the Tokyo stock exchange: a bird's eye view. J Finance 49(3):951–984

Madhavan A (2000) Market microstructure: a survey. J Financ Markets 3(3):205–258

O'Hara M (2003) Presidential address: liquidity and price discovery. J Finance 58(4):1335–1354

Chapter 3
An Overview of Securities Market Regulation Around the World

Pratip Kar

3.1 Chapter Introduction and Objectives

On 16 March 2008, under the supervision of the Federal Reserve of the United States, Bear Sterns, one of the largest global investment banks, signed a merger agreement with J P Morgan Chase. The Federal Reserve issued a nonrecourse loan of $30 billion to cover losses in Bear Sterns' investments in mortgage-backed securities and exotic instruments. In 2005–2007, Bear Sterns was recognized as the "most admired" securities firm in Fortune's "America's Most Admired Companies" survey.

Likewise, in 2001, after a series of revelations involving irregular accounting procedures bordering on fraud, Enron filed for the largest bankruptcy in the United States. Interestingly, Enron was also voted the most admired company by Fortune three times in a row!

The collapse of firms like Enron, Bear, Sterns & Co Inc. and the accounting scandals like World.com have raised serious concerns about the regulation and financial reporting norms.

In this chapter, we present some principles of financial services/securities market regulation in countries around the world.

This chapter has the following objectives:

- Highlight the role of regulatory bodies
- Present a summary of regulation in countries drawn from North America, Europe, and the Asia Pacific.

Recent scandals in the United States highlight both the importance and the fallibility of the securities market intermediary institutions to which investors typically turn for protection, such as auditors, analysts, and advisory firms. The organized interaction of buyers and sellers in securities markets serves three key purposes: price

P. Kar
Tata Management Training Centre, 1 Mangaldas Road, Pune, India

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_3,

discovery, liquidity provision, and reduction of search and information costs. In a world of perfect markets and perfect competition, there is no theoretical justification for intervention in market mechanisms – but the story is different if these conditions are violated. Reasons to justify such regulations include investor protection, enhancement of the markets' ability to function, and safeguarding of systemic stability.

Central banks have an interest in securities market regulation issues, particularly because of their core task of safeguarding purchasing power and financial stability. In a "global village," regulation is at once in a (financial centre) competitive situation, yet is increasingly being conducted in a framework of international cooperation. Rulemaking in the European Union is dedicated to the creation of a single market for financial services.

This chapter discusses reasons for regulation and describes the principles, forms, and development trends of securities market regulation. It also provides an overview of securities regulation in several countries.

3.2 Aims of Regulation

If securities markets perform their intended functions (to reach an equilibrium, i.e., a market-clearing price; to provide selling and buying opportunities, i.e., liquidity; and to reduce transaction costs) efficiently, that is, at the lowest possible costs, there is no (or at least no exclusively welfare-theoretical) justification for public intervention. The conventional justification for regulation is therefore that, because exchanges on securities markets lead to external effects (for nonparticipating and therefore nonconsidered third parties), there is a public interest in protecting potentially disadvantaged parties for reasons of market structure (the number and size of sellers, economies of scale, and network effects) and owing to information asymmetry. In this light, the regulation and supervision of securities markets is important for investor protection, the safeguarding and maintenance of a functioning competitive framework, and the prevention of potential systemic risks. Markets that adequately fulfill their functions of price discovery and ensuring opportunities for competitive trading promote – in competition with financial institutions – the efficient allocation of capital. Consequently, economic resources are deployed appropriately and risk is assigned to those parties who are best able to bear it. This represents the optimum utilization of an economy's growth and employment potential.

Regulation is not an end in itself. The regulatory framework therefore has to be assessed in terms of its effectiveness. It must be operationally efficient, that is, fulfill the desired functions. The best reflection of the quality of effective securities regulation is the extent to which it ensures a functioning market mechanism. The benefits of regulation have to be compared with the costs, as regulation ties up resources on the part of both the financial industry and supervisors. It generates costs, which are ultimately passed on to the market players. In addition, opportunity costs are created if market players' preferences are met either only partially or not at all, or if innovation is hampered. This is a danger that generally exists in an overregulated environment. Although, in practice, it is difficult to carry out a cost-benefit analysis, it is an indispensable element of a sound regulatory framework.

The rest of the chapter reviews the securities market regulation in countries around the world.

3.3 Securities Market Regulation in the United States[1]

Following the stock market crash in October 1929 in the United States, public confidence in the markets plummeted. Investors large and small, as well as the banks who had loaned to them, lost great sums of money in the ensuing Great Depression. There was a consensus that for the economy to recover, the public's faith in the capital markets needed to be restored. Congress held hearings to identify the problems and search for solutions.

On the basis of findings in these hearings, Congress – during the peak year of the Depression – passed the Securities Act of 1933. This law, together with the Securities Exchange Act of 1934, which created the SEC, was designed to restore investor confidence in our capital markets by providing investors and the markets with more reliable information and clear rules of honest dealing.

Monitoring the securities industry requires a highly coordinated effort. Congress established the Securities and Exchange Commission in 1934 to enforce the newly passed securities laws, to promote stability in the markets and, most importantly, to protect investors. President Franklin Delano Roosevelt appointed Joseph P. Kennedy, President John F. Kennedy's father, to serve as the first Chairman of the SEC.

3.4 Governance of SEC

The SEC consists of five presidentially appointed Commissioners, with staggered 5-year terms. One of them is designated by the President as Chairman of the Commission – the agency's chief executive. By law, no more than three of the Commissioners may belong to the same political party, ensuring non-partisanship. The agency's functional responsibilities are organized into 4 divisions and 19 offices, each of which is headquartered in Washington, DC. The Commission's approximately 3,500 staff are located in Washington and in 11 regional offices throughout the country.

It is the responsibility of the Commission to do the following:

- Interpret federal securities laws
- Issue new rules and amend existing rules

[1] This section is based on the information provided on the SEC Web site.

- Oversee the inspection of securities firms, brokers, investment advisers, and ratings agencies
- Oversee private regulatory organizations in the securities, accounting, and auditing fields
- Coordinate US securities regulation with federal, state, and foreign authorities

The SEC has several divisions and offices to enforce laws and they are as follows:

- The division of corporation finance. It assists the Commission in executing its responsibility to oversee corporate disclosure of important information to the investing public.
- The division of trading and markets. It assists the Commission in executing its responsibility for maintaining fair, orderly, and efficient markets. The staff of the division provides day-to-day oversight of the major securities market participants: the securities exchanges; securities firms; self-regulatory organizations (SROs) including the Financial Industry Regulatory Authority (FInRA), the Municipal Securities Rulemaking Board (MSRB), clearing agencies that help facilitate trade settlement; transfer agents (parties that maintain records of securities owners); securities information processors; and credit rating agencies.
- The division of investment management. It assists the Commission in executing its responsibility for investor protection and for promoting capital formation through oversight and regulation of America's $26 trillion investment management industry.
- The division of enforcement. It assists the Commission in executing its law enforcement function by recommending the commencement of investigations of securities law violations, by recommending that the Commission bring civil actions in federal court or before an administrative law judge and by prosecuting these cases on behalf of the Commission.

3.5 Financial Services Regulation in Asia

In this section, we cover financial services regulation in some of the Asian countries like China, Hong Kong, Japan, India and Singapore.

3.5.1 China

The China Securities Regulatory Commission (CSRC), the China Banking Regulatory Commission (CBRC), the China Insurance Regulatory Commission (CIRC), and the People's Bank of China (PBOC) are the main bodies responsible for regulating financial services in the PRC.

The CSRC has the ultimate responsibility for regulation in relation to the stock markets in Shanghai and Shenzhen, the futures exchange in Shanghai, and the commodities exchanges in Zhengzhou and Dalian, with the local exchanges retaining certain front-line regulatory functions under CSRC supervision. The CSRC

- Sets regulations governing the markets
- Regulates listed companies, securities, and futures brokers
- Oversees stock and bond issues
- Supervises the establishment and operation of investment funds
- Has jurisdiction over the auditors of publicly listed companies and law firms, which provide advice in relation to the issue, listing, or trade of securities
- Appoints the head of each exchange
- Approves the directors and senior officers of securities companies

Since 2003, banking regulation has primarily been carried out by the CBRC. It has broad supervisory and disciplinary functions in relation to banking activities in mainland China: amongst other things, it licenses banking institutions, sets their authorized business scope and formulates and enforces regulations governing their operation. In addition to its role in relation to monetary policy, the PBOC (the central bank of China) retains responsibility for the inter-bank lending, bonds, and foreign exchange markets, and is the lead agency for anti-money laundering activities.

The CIRC regulates the mainland Chinese insurance market. In addition to setting regulations, it oversees the establishment and operation of insurance companies and their subsidiaries and monitors the standard of insurance agents and insurance companies' senior management.

3.5.2 Hong Kong

The main bodies responsible for regulating financial services in Hong Kong are the following:

- Securities and Futures Commission ("SFC")
- Stock Exchange of Hong Kong Limited ("Stock Exchange")
- Hong Kong Futures Exchange Limited ("Futures Exchange")
- Hong Kong Monetary Authority ("HKMA")
- Office of the Commissioner of Insurance ("OCI")

The SFC is responsible for regulating the securities and futures market. In this regard, the SFC performs a number of supervisory roles and is accorded extensive regulatory powers to enable it to perform its functions. First, the SFC is responsible for issuing licences to all corporations and individuals wishing to engage or engaging in a wide range of activities, namely, dealing in securities and futures contracts, leveraged foreign exchange trading, advising on securities, futures contracts and corporate finance, providing automated trading services, securities margin financing and asset management.

The SFC also oversees the Hong Kong Exchanges and Clearing Limited ("HKEx"), which is the holding company of the Stock Exchange and the Futures Exchange. The Stock Exchange is the front-line regulator of stock exchange participants and companies listed on the Main Board and Growth Enterprise Market ("GEM") of the Stock Exchange. The Futures Exchange is primarily responsible for regulating futures exchange participants. The SFC retains regulatory supervision over the operations of listed companies in a number of ways, including decisions to exempt from prospectus requirements and investigating listed companies for suspected prejudicial or fraudulent transactions or for providing false or misleading information to the public. The SFC is also responsible for the discipline and sanctioning of sponsors and compliance advisers. The SFC also regulates all persons participating in securities and futures trading by investigating and taking action in respect of market misconduct and other breaches of securities and futures law.

The HKMA regulates the banking industry and generally performs the obligations of a central bank. The OCI supervises a self-regulation system governing the insurance industry, with a view to protecting the interests of policy holders. Insurance intermediaries such as agents and brokers are required to be registered with various self-regulatory bodies which ensure their proper conduct. The OCI is responsible for granting authorization to insurers to carry on insurance business and examining their financial statements and returns. Where an individual or a corporation provides services falling within the jurisdiction of two or more regulators, such individual or corporation would be subject to the regulation by each of the regulators concerned. A number of Memoranda of Understanding ("MOUs") have been signed by regulatory bodies setting out each regulator's roles and responsibilities in situations where there is an overlap of jurisdiction.

3.5.3 Japan

The main bodies responsible for regulating financial services in Japan are the following:

- Financial Services Agency ("FSA")
- Securities and Exchange Surveillance Committee ("SESC")
- SROs, such as the various securities exchanges and the Japan Securities Dealers Association

The FSA is an external organ of the Cabinet office and is responsible for financial services supervision and this includes the following:

- Maintaining the stability of the financial system in Japan, protecting depositors, insurance policy holders, and securities investors
- Planning and policy making concerning financial systems
- Inspecting and supervising private sector financial institutions (such as banks, securities companies, and insurance
- Companies and market participants, including securities exchanges
- Establishing rules for trading in securities markets
- Participating in international forums, contributing to the coordination of international financial administration policy

- Engaging in surveillance of compliance with rules governing securities markets
- Administering financial regulations by issuing orders of revocation or suspension of licences, imposing disciplinary sanctions, or ordering remedial measures

The FSA consists of a number of organs, including the SESC and the Certified Public Accountants and Auditing Oversight Board ("CPAAOB"), each of which is responsible for a particular area of financial regulation. The SESC operates to protect investors and ensure the integrity of the securities and futures markets. It is tasked with ensuring that companies engaging in financial services activities comply with securities and financial futures markets regulations. The SESC is empowered to conduct compulsory and non-compulsory inspections of entities suspected of involvement in criminal activity, such as violations of disclosure regulations, for market manipulation and insider trading. Compulsory inspections, which include detailed searches of a suspect's premises and the seizing of evidence, require the SESC to obtain a warrant from a judge. Where investigations reveal that an entity has been acting in contravention of regulations, the SESC may file a formal complaint which can lead to criminal prosecution. SROs, such as the various securities exchanges and the Japan Securities Dealers Association ("JSDA"), also play a significant part in regulating financial services in Japan. These organizations are established voluntarily and set their own regulatory framework within the remit set out by primary legislation. Their primary aim is to ensure fairness in trading and to protect the interests of investors.

There are currently four types of SROs: the securities exchanges, the JSDA, the Japan Securities Investment Advisers Association and the Japan Investment Trusts Association, and each regulates its members in accordance with its own rules. For example, the securities exchanges regulate their member securities companies by means of rules governing the trading and settlement of listed securities, as well as rules in relation to listing conditions and procedures. The JSDA regulates its member securities companies (effectively all securities companies in Japan since all are members of the organization) by its rules, including its "Rules of Fair Practice" which regulate over-the-counter securities transactions, registration of securities in the over-the-counter market, solicitation of investments to customers and securities underwriting.

3.5.4 India

The main bodies responsible for regulating financial services in India are the following:

- Securities and Exchange Board of India ("SEBI")
- Reserve Bank of India ("RBI")
- Ministry of Finance ("MoF")
- Insurance Regulatory and Development Authority ("IRDA")
- Forward Markets Commission ("FMC")

SEBI is the peak body regulating the securities markets in India. It was established to protect the interests of investors in securities and to permit the development and effective regulation of the securities markets. SEBI regulates the business in stock exchanges and other securities markets. SEBI is responsible for registering and regulating the operations of various intermediaries in the securities markets including stockbrokers, foreign institutional investors, merchant bankers, underwriters, portfolio managers, depositories, and credit rating agencies. It also regulates venture capital funds and investment schemes including mutual funds. SEBI also has primary responsibility for preventing, prohibiting, and punishing fraudulent and unfair trade practices relating to the securities markets.

RBI regulates the banking industry and generally performs the obligations of a central bank. Its functions include acting as a banker to the Government, regulating the issue of currency in India, acting as a banker to other commercial banks, exercising control over the volume of credit of commercial banks to maintain price stability, controlling advances granted by commercial banks, and developing policies on the rates of interest on which advances may be granted by banks. RBI is also responsible for maintaining the official exchange rate of the rupee. RBI acts as the custodian of India's international currency reserves and administers foreign exchange controls.

In addition to its traditional central banking functions, RBI has certain non-monetary functions including supervision of banks and nonbanking institutions (whether or not such institutions receive deposits from the public), ensuring proper management of banks and promoting sound banking practices. The RBI also regulates transactions in derivatives, money and market instruments, other than derivatives/instruments traded on a recognized stock exchange.

IRDA regulates the insurance sector in India. It regulates, promotes, and ensures the orderly growth of the insurance and re-insurance business. IRDA also administers legislation governing the operation of insurance companies and insurance intermediaries with a view to protecting the interests of policyholders.

FMC is the primary regulatory authority of the forward commodities market. Its functions, which are mainly advisory, are administered by the Ministry of Consumer Affairs and Public Distribution. The FMC advises the Central Government in relation to the recognition or withdrawal of recognition of intermediaries, associations and other participants in the forward market. It also has responsibility to keep the forward market under observation, collect information and make recommendations for improvements in the working of the forward market. The forward market is also regulated by rules and laws of registered associations.

The MoF also plays an important role in the financial sector. Before the reforms of the 1990s, MoF was responsible for supervising the rules and regulations governing the banking and securities market. MoF is involved in legislative issues and policy matters that are beyond the domain of any one regulator.

The principal legislation regulating the securities market is the Securities and Exchange Board of India Act 1992 ("SEBI Act"), the Securities Contracts (Regulation) Act 1956 ("SCRA") and associated subsidiary legislation. SEBI also issues guidelines and circulars regulating specific issues such as investments by foreign institutional investors and foreign venture capital funds. SEBI also monitors stock exchanges through subsidiary legislation under the SEBI Act and the SCRA. Stock exchanges, on the contrary, regulate the securities markets on the basis of contractual arrangements that make its rules and the listing agreement binding on listed entities and member intermediaries like stock brokers.

3.5.5 Singapore

The main bodies responsible for regulating financial services in Singapore are the following:

- The financial services industry in Singapore is governed by three main institutions:
- The Monetary Authority of Singapore ("MAS")
- The Singapore Exchange Securities Trading Limited ("SGX")
- The Securities Industry Council ("SIC")

The MAS is Singapore's central bank. It also regulates the securities, banking and insurance sectors.

The role of the MAS is to

- Conduct monetary policy and issue currency
- Administer various statutes pertaining to monetary, banking, insurance, securities and the financial sector in general
- Supervise the banking, insurance, securities and futures industries
- Manage the official foreign reserves and the issuance of government securities
- Develop strategies in partnership with the private sector to promote Singapore as an international financial centre

The SGX is the Asia Pacific's first demutualized and integrated securities and derivatives exchange. Its members include trading derivatives and trading securities organizations ("Members"). The SGX operates the securities and derivatives exchange and the respective clearing houses and securities depository. The SGX performs all steps in the value chain of businesses – order routing, trading, matching, clearing, settlement and depository functions.

The SGX is responsible for the following:

- Regulating the stock market
- Approving applications for listing
- Provision and administration of business and listing rules
- Supervising admission of members and compliance by listed companies with the listing rules and corporate disclosure policies
- Market surveillance and risk management for clearing of securities and derivatives
- Overseeing the capital requirements of brokers and investigating brokers as and when it deems necessary

The SIC is an advisory body that assists the finance minister on all matters relating to the securities industry. The SIC remains a non-statutory body consisting of representatives from the MAS, private and public sectors or such persons as the minister may appoint.

The SIC's role is to

- Administer and enforce the Singapore Code on Takeovers and Mergers ("Takeover Code")
- Supervise the application of the Takeover Code where a takeover or merger occurs
- Investigate any dealing in securities connected with a takeover or merger transaction
- Issue rulings on the interpretation of the Takeover Code and lay down the practice to be followed by the parties in a takeover or merger; and review the takeover rules and practices periodically and recommend changes

3.6 Financial Services Regulation in Europe

In this section, we review regulation in the UK and France.

3.6.1 France

The Autorité des marchés financiers (AMF) established by the Financial Security Act of 1 August 2003. It was formed from the merger of the Commission des opérations de bourse (COB), the Conseil des marchés financiers (CMF) and the Conseil de discipline de la gestion financière (CDGF).

The objective in amalgamating these bodies was to improve the efficiency of France's financial regulatory system and to give it greater visibility. The AMF is an independent public body with legal personality and financial autonomy. Its remit is to

- Safeguard investments in financial instruments and in all other savings and investment vehicles
- Ensure that investors receive material information
- Maintain orderly financial markets

The AMF also lends its support to financial market regulation at the European and International levels.

The AMF comprises the following:

- A Board with 16 members
- A Enforcement Committee with 12 members
- Specialized commissions and consultative commissions

The Finance Minister designates a representative of the Government who has a non-voting seat on all AMF bodies. The Chairman of the AMF is named by decree of the President of the Republic for a non-renewable 5-year term.

The AMF has a staff headed by a Secretary General. The staff is composed of public servants under contract, private employees and public servants. At year-end 2003 the headcount was 320.

3.6.2 Responsibilities

The AMF has four kinds of responsibilities:

- Regulation
- Authorization
- Supervision
- Enforcement

It has jurisdiction over the following:

- Disclosures and Corporate Finance: The AMF sets rules for and monitors transactions involving the securities of publicly traded companies (initial public offerings, capital increases, mergers, etc.) and ensures that tender offers are conducted in orderly fashion. It also monitors companies to ensure that they provide complete, relevant information on a timely basis and in an equitable manner to all market participants (investors, analysts, fund managers, the press, the general public, etc.)
- Collective investment products: The AMF authorizes the formation of collective investment schemes (SICAVs and FCPs) and reviews the information in the prospectus that must be given to customers before subscription. For complex products such as structured funds and funds with guarantees or other protection features, the AMF ensures that special characteristics are clearly disclosed, and their consequences explained, to potential investors.
- Exchanges and market infrastructure: The AMF establishes principles of organization and operation for market undertakings (such as Euronext Paris) and settlement systems (e.g. Euroclear France). It approves the rules of clearing houses (e.g. Clearnet) and sets conduct-of-business rules for their members. It monitors the markets and the transactions that take place on them.
- Professionals: (credit institutions authorized to provide investment services, investment firms, investment management companies, financial investment advisers, direct marketers). The AMF establishes conduct of business rules and professional obligations that must be observed by persons authorized to provide investment services or advise on financial investments. It registers and approves investment management companies at the incorporation stage, assessing the skills, fitness and propriety of corporate officers as well as the adequacy and suitability of the company's resources. The AMF also establishes conduct-of-business rules for custody and administration of financial instruments.

The AMF thus combines the regulatory jurisdictions of the COB, the CMF and CDGF. In addition, it has two new responsibilities:

- Supervision of financial investment advisers: The Financial Security Act establishes a new legal category of financial investment advisers and gives the AMF the responsibility of ensuring that financial investment advisers honour their professional obligations. Any breach of the laws, regulations or professional obligations applicable to advisers is subject to sanctions imposed by the AMF.
- Oversight of rating agencies: The AMF will publish a report annually on the role of rating agencies, their rules of conduct, the transparency of their methods, and the impact of their activity on issuers and financial markets.
- The AMF shares with other authorities the responsibility for supervising direct marketers. The Financial Security Act recasts the regulatory regime for the unsolicited promotion of banking and financial products and services ("cold calling"). It entrusts the supervision of persons engaging in this activity to the AMF, the Comité des établissements de crédit et des entreprises d'investissement (CECEI) and the Comité des entreprises d'assurance (CEA), according to their respective jurisdictions.
- The AMF may also conduct inspections and investigations; and, when practices are found to contravene its General Regulation or professional obligations, its Enforcement committee may impose sanctions or penalties.

When the facts of a case suggest a criminal offence, the AMF Board transmits the report of its inspection or investigation to the public prosecutor.

The AMF is empowered to adjudicate any complaint relating to financial instruments or financial markets. Its ombudsman may propose settlements to resolve disputes brought to his attention.

3.7 Financial Services Regulation in the UK

The Financial Services Authority (FSA) is an independent organization responsible for regulating financial services in the UK. The FSA's aim is to promote efficient, orderly and fair financial markets and help retail financial service consumers get a fair deal. The FSA was set up by government. The government is responsible for the overall scope of the FSA's regulatory activities and for its powers. The FSA regulates most financial services markets, exchanges and firms. It sets the standards that they must meet and can take action against firms if they fail to meet the required standards.

The FSA is an independent non-governmental body, given statutory powers by the Financial Services and Markets Act 2000. FSA is a company limited by guarantee and financed by the financial services industry. The Treasury appoints the FSA Board, which currently consists of a Chairman, a Chief Executive Officer, three Managing Directors, and nine non-executive directors (including a lead non-executive member, the Deputy Chairman). This Board sets the overall policy, but day-to-day decisions and management of the staff are the responsibility of the Executive.

The Chancellor of the Exchequer announced the reform of financial services regulation in the UK and the creation of a new regulator on 20 May 1997. The Chancellor announced his decision to merge banking supervision and investment services regulation into the Securities and Investments Board (SIB). The SIB formally changed its name to the Financial Services Authority in October 1997. The first stage of the reform of financial services regulation was completed in June 1998, when responsibility for banking supervision was transferred to the FSA from the Bank of England. In May 2000, the FSA took over the role of UK Listing Authority from the London Stock Exchange. The Financial Services and Markets Act, which received Royal Assent in June 2000 and was implemented on 1 December 2001, transferred to the FSA the responsibilities of several other organizations:

- Building Societies Commission
- Friendly Societies Commission
- Investment Management Regulatory Organization
- Personal Investment Authority
- Register of Friendly Societies
- Securities and Futures Authority

In addition, the legislation gives FSA some new responsibilities – in particular, taking action to prevent market abuse.

In October 2004, following a decision by the Treasury, FSA took on the responsibility for mortgage regulation. In January 2005, to implement the Insurance Mediation Directive and in accordance with a Government announcement in 2004, we took on regulation of general insurance business.

FSA currently regulates over 29,000 firms with a diverse range of sizes and activities. In January 2000, FSA set out its proposed approach to regulation in "New Regulator for the New Millennium." This explained the operating framework it intended to put in place to enable it to meet its statutory objectives. This framework is more commonly known as ARROW, which stands for the Advanced, Risk-Responsive Operating Framework, and it is at the heart of the FSA's risk-based approach to regulation.

3.8 International Capital Markets Regulation

Apart from the national capital market regulatory bodies, there is also an international capital market association that provides a self-regulatory framework. The International Capital Market Association (ICMA) is the self-regulatory organization (SRO) and trade association representing the financial institutions active in the international capital markets worldwide. ICMA's members are located in some 50 countries across the globe, including all the world's main financial centers and currently number over 400 firms in total. ICMA members are not only geographically widespread but also vary considerably in size and type of activities. They range from the largest global investment banks with a presence in numerous countries, to small regional banks primarily servicing retail bond investors. ICMA market conventions and standards have been the pillars of the international debt market for almost 40 years, providing the self-regulatory framework of rules governing market practice which have facilitated the orderly functioning and impressive growth of the market.

ICMA is unique amongst financial industry associations in that it represents a broad range of capital market interests, its 400 strong international membership includes both global investment banks and smaller regional banks, as well as asset managers, exchanges, central banks, law firms, and other professional advisers, making it an influential voice for the global market. There is no central location where trading in the international capital market takes place. Despite the substantial development of electronic trading systems in recent years, the majority of transactions are still executed "over the counter" by market participants who are likely to be located in different countries.

The market is also characterized by a wide variety of issuers, issuing currencies, credit quality, and technical specifications of the securities themselves. ICMA maintains standards of good market practice in the primary markets and has developed standard documentation for new issues leading to greater efficiencies and cost savings for issuing banks.

Because of its inherent cross-border nature, the international capital market is not subject to the same degree of regulation that governs domestic primary and secondary markets. In this marketplace, ICMA has, for some 40 years, performed a crucial central role by providing and enforcing a self-regulatory code of industry-driven rules and recommendations which regulate issuance, trading and settlement in the international capital market.

3.9 Governance of ICMA

ICMA's board, comprising elected individuals drawn from member firms, is responsible for deciding major policy issues and approving amendments to the ICMA rules and recommendations. ICMA's Executive President is an ex-officio member of the board and heads the Association's secretariat in Zurich. ICMA's committees which are the direct link between the Association and the market are also composed of elected individuals who are actively involved in the market. ICMA is based in Zurich where it was founded as an Association under Swiss law in 1969 and has offices in London.

ICMA liaises closely with regulators and governmental authorities, both at the national as well as at the supranational level, to ensure that financial regulation promotes the efficiency and cost-effectiveness of the capital markets.

3.10 Concluding Comments

Securities markets make an important contribution to the integration process and the momentum of economic growth. There is a general consensus that securities markets need to be regulated as well as the extensive agreement about the aims and principles of such regulation. The regulatory framework must be adapted to both the market structure and market developments, and must be continually refined. Flexible regulation enhances competitiveness and thus contributes to financial stability. In view of financial market globalization, it has for a long time already been impossible to regulate from a purely national perspective. After all, the competition between financial centres runs parallel to the competition between regulatory systems. In order for locations to survive in this competitive environment, the level of regulation and its degree of restrictiveness in the various economic areas will tend to converge.

In this process, one element that will need to be checked is whether regulatory goals can be achieved more efficiently through self-regulation or statutory regulation. Another major issue for discussion is the extent to which the international coordination of regulatory measures and bodies is better suited to meeting challenges which are similar the world over than if nations either act alone or restructure their supervisory regimes.

3.11 End of the Chapter Questions

1. What are the intended functions of security market reforms?
2. How is the Securities and Exchange Commission governed?
3. Which are the main bodies responsible for regulating financial services in China?
4. Which are the main bodies responsible for regulating financial services in Hong Kong?
5. Which are the main bodies responsible for regulating financial services in Japan?
6. Which are the main bodies responsible for regulating financial services in India?
7. What are the roles and responsibilities of AMF in France?
8. What role is played by ICMA in international capital market regulation?

References

(2007) Principles of Financial Regulation, Securities and Investment Institute, London, 4th ed.
Smith H (2007) Guide to Financial Services Regulation in Asia. Herbert Smith LLP, Hong Kong.

Chapter 4
The Capital Asset Pricing Model and Arbitrage Pricing Theory: Theory

S.R. Vishwanath

4.1 Chapter Introduction and Objectives

For a long time, academic theorists were grappling with explaining the variation in cross section of expected stock returns. That is, we need a model to link the risk and return of investing in stocks and other assets. The breakthrough came when Markowitz, and later Sharpe, laid the foundations of modern portfolio theory. The capital asset pricing model (CAPM) hypothesizes that a stock's return is a function of its systematic risk. The model is simple and intuitive to use. But, it has come under attack from other academics because of its inability to adequately explain ex-post variation in cross section of stock returns and several anomalies in the US capital markets. The arbitrage pricing theory has emerged as one of the competitors to CAPM. This chapter describes these two theories of asset pricing.

This chapter has the following objectives:

- Describe how to measure returns of individual and portfolios of stocks
- Explain what constitutes risk in a single stock as well as a portfolio context
- Review the performance of major markets around the world
- Introduce CAPM and APT

Suppose an investor purchased 100 shares of a company at $ 120, received dividends amounting to $ 60 during the year, and sold the shares at $ 140 at the end of the year. The rate of return an investor receives from buying shares and holding them for a given period of time is equal to the cash dividends received plus the capital gain (or minus the capital loss) during the holding period divided by the purchase price of the security.

S.R. Vishwanath
Institute of Management Technology, 603, Khullar Apartments, Byramji Town, Nagpur 440001, India
e-mail: srvishy@gamil.com

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_4,

Expressed as a formula, realized return

$$R = \frac{[D_1 + (P_1 - P_0)]}{P_0}, \tag{4.1}$$

where D_1 = dividend received; P_1 = selling price; P_0 = purchase price

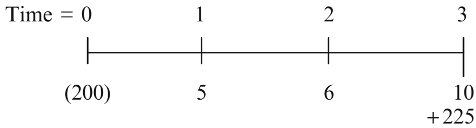
The rate of return on the investment = $(\$60 + \$20)/120 = 66.66\%$.

Now consider a multi-period situation. The investor has a 3-year investment horizon.

Purchase price = \$ 200

Dividend receipts = \$ 5, \$ 6, and \$ 10, respectively.

Selling price = \$ 225



One measure of return is the arithmetic average of returns in these 3 years.

$$R = \frac{[R_1 + R_2 + R_3]}{3},$$

where R is the average return and R_1, R_2, and R_3 are periodic returns.

Another measure is the geometric mean of returns.

$$R_g = [(1 + R_1)(1 + R_2)(1 + R_3)]^{1/3} - 1.$$

In general, the geometric mean can be expressed as follows:

$$R_g = [(1 + R_1)(1 + R_2)(1 + R_3)\ldots(1 + R^N]^{1/N} - 1. \tag{4.2}$$

In the above equation, N is the number of periods. In the above example, the investor had a 3-year horizon. The holding period could be in months as well, say, January, February, and March. The principle remains the same, except that the rate of return will have to be converted to an annual rate.

Exhibit 4.1 presents the summary of returns on common stocks in the US [proxied by S&P (Standard and Poor) index] between 1871 and 2001. The returns are calculated using monthly data and assume that dividends are reinvested at each month-end. The geometric mean of returns for the entire period is 9.0641%.

Investors receive returns in two forms: dividends and capital gains. The dividend return on the S&P 500 index has declined to about 1.5% in 2000s from 3.5% to 4.0% in the 1960s. Academic studies in the United States have attempted to forecast future stock returns using dividend yields and expected rates of growth in stock price appreciation (Jones et al. 2002). An important study by Fama and French (2001) suggests that the propensity of firms to pay dividends is lower now, suggesting that

Exhibit 4.1 Dividend, appreciation and total returns on common stocks 1871–2001

Time period	Returns	Mean (%)	Standard deviation (%)
Panel A. Arithmetic summary statistics			
1871–2001	Dividend	4.6313	1.3052
	Appreciation	5.8371	18.0031
	Total	10.4685	18.1167
Panel B. Geometric summary statistics			
1871–2001	Dividend	4.6419	1.3696
	Appreciation	4.2261	1.3696
	Total	9.0641	19.2980

Source: Jones, et al. (2002)

dividend returns are unlikely to grow. Academic studies take several proxies for the stock price appreciation (e.g., GDP growth rate). These studies suggest that stock returns are likely to be in the range of 7–9%.

4.2 Measuring Portfolio Return

The return on a portfolio of stocks, as opposed to a single stock, could be written as

$$R_p = [D_p + (V_1 - V_0)]/V_0, \tag{4.3}$$

where R_p = portfolio return; D_p = dividend receipts; V_1 = value of the portfolio at the end of the period; V_0 = value of the portfolio at the beginning of the period.

To illustrate, if an investor were to purchase shares of three companies at \$ 1 million and sell them when the value of the portfolio is \$ 1.2 million, the return on the portfolio (ignoring dividends) is as follows:

$$\frac{\$(1.2 - 1.0)\,\mathrm{m}}{1.0\,\mathrm{m}} = 20\%.$$

The above formulation is based on the assumption that the investor does not withdraw.

4.3 Measuring Risk

Investors buy shares in anticipation of a particular return, but the fluctuation in stock prices result in fluctuating returns. Therefore, shares are considered risky. As the returns from government securities like Treasury bills do not deviate from their expected returns, they are considered risk free. Financial theory defines risk as the possibility that actual returns will deviate from expected returns. The degree of potential fluctuations determines the degree of risk. More specifically, the risk in holding a security is the variance in expected returns. The variance in returns measures the disparity between actual and expected returns. Modern finance theory hypothesizes that investors choose securities on the basis of expected return and standard deviation (square root of variance). So, given a choice between two investments with same expected return, the investor would choose the one with lower standard deviation. Any portion of initial investment or inject fresh investment during the period or dividend receipts are not reinvested. If any of these occur, the formula may have to be modified suitably. The portfolio return in case of a multi-period situation may be written as

$$V_0 = \left[\frac{D_1}{(1+r)^1}\right] + \left[\frac{D_2}{(1+r)^2}\right] + \cdots\cdots + \left[\frac{(D_N + V_N)}{(1+r)^N}\right], \tag{4.4}$$

where $D_1, D_2, \ldots, D_N$ are dividend receipts, V_0 and V_1 are values of portfolio at the beginning and end of the holding period. The rate r that equates cash inflows and cash outflows is the return on the portfolio. The concept is similar to the YTM of a bond.[1] The calculation is based on the assumption that dividend receipts are reinvested at $r\,\%$. Although the above example considers a stock portfolio, the concept can be extended to portfolio of other assets as well.

Exhibit 4.2 presents the monthly returns on the S&P 500 index and some prominent stocks in the United States.

Two such investments are shown in Exhibit 4.3. Investment B is preferable as its variance is lower.

The arithmetic average of past realized return is taken as a proxy for future expected returns. Assume that a hypothetical stock has yielded the following returns in the past:

Historical period year	Gross return (i.e., $1 +$ net return) (%)
1	1.015
2	0.87
3	1.10
4	1.29
5	1.26
25	1.15
Average	1.054 or 5.4

This average can be used to forecast future cumulative returns by compounding. The cumulative return, for example, after 1 year in future is $(1.054)^1 = 1.054$ and after 25 years it is $(1.054)^{25}$.

[1] YTM is the yield to maturity of a bond. It is the rate that equates periodic coupon receipts and principal repayments and the market price of the bond. YTM is explained later in the chapter on debt markets.

Exhibit 4.2 Monthly returns on the index as well as some US stocks (2003–2005)

Month/Year beginning	S&P 500 (%)	3M (%)	AIG (%)	Alcoa (%)
	−2.74	1.02	−6.46	−13.21
Monday, February 03, 2003	−1.70	1.19	−8.93	4.48
Monday, March 03, 2003	0.84	3.72	0.43	−5.48
Tuesday, April 01, 2003	8.10	−3.07	17.18	19.13
Thursday, May 01, 2003	5.09	0.87	−0.12	7.34
Monday, June 02, 2003	1.13	1.99	−4.57	3.59
Tuesday, July 01, 2003	1.62	8.69	16.34	8.91
Friday, August 01, 2003	1.79	2.08	−7.21	3.41
Monday, September 01, 2003	−1.19	−3.04	−3.03	−8.39
Wednesday, October 01, 2003	5.5	14.19	5.42	20.67
Monday, November 03, 2003	0.71	0.65	−4.74	4.41
Monday, December 01, 2003	5.08	7.58	14.51	15.84
Thursday, January 01, 2004	1.73	−6.99	4.77	−10.05
Monday, February 02, 2004	1.22	−0.91	6.55	10.11
Monday, March 01, 2004	−1.64	4.92	−3.50	−7.41
Thursday, April 01, 2004	−1.68	5.63	0.42	−11.35
Monday, May 03, 2004	1.21	−1.78	2.31	2.26
Tuesday, June 01, 2004	1.80	6.44	−2.66	5.54
Thursday, July 01, 2004	−3.43	−8.50	−0.89	−3.03
Monday, August 02, 2004	0.23	0.46	0.84	1.58
Wednesday, September 01, 2004	0.94	−2.90	−4.46	3.74
Friday, October 01, 2004	1.40	−3.00	−10.70	−3.24
Monday, November 01, 2004	3.86	3.06	4.33	5.05
Wednesday, December 01, 2004	3.25	3.12	3.79	−7.58
Monday, January 03, 2005	−2.53	2.79	0.95	−6.05
Tuesday, February 01, 2005	1.89	0.00	0.77	9.42
Tuesday, March 01, 2005	−1.91	2.08	−16.89	−5.41
Friday, April 01, 2005	−2.01	−10.75	−8.23	−4.48
Monday, May 02, 2005	3.00	0.78	9.23	−6.16
Wednesday, June 01, 2005	−0.01	−5.67	4.83	−3.55
Friday, July 01, 2005	3.60	3.73	3.62	7.31
Monday, August 01, 2005	−1.12	−4.58	−1.42	−3.97
Thursday, September 01, 2005	0.69	3.11	4.66	−8.86
Monday, October 03, 2005	−1.77	3.58	4.58	−0.54
Tuesday, November 01, 2005	3.52	3.84	3.61	13.55
Thursday, December 01, 2005	0.70	−0.36	1.89	8.03

But, this mathematical expected cumulative return is always higher than *median* cumulative return. A better procedure for estimating returns is to find the natural log of gross returns in each of the years in the past, take an average, and use this average to find cumulative returns in the future (Hughson et al. 2006). The distribution of returns generated by cumulative return distribution becomes more skewed towards

Exhibit 4.3 Mean and standard deviation of returns

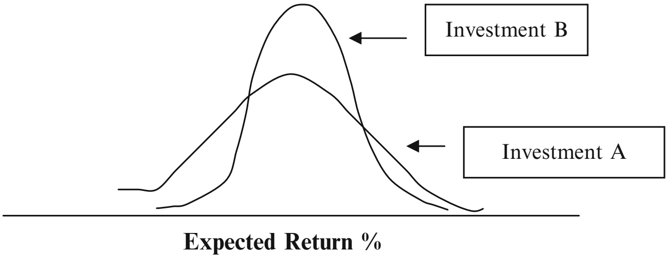


Exhibit 4.4 Annualized arithmetic mean of real returns (inflation adjusted) on major asset categories around the world, 1900–2000%

Country	Equities	Bonds	Bills
Australia	9.0	1.9	0.6
Belgium	4.8	0.3	0.0
Canada	7.7	2.4	1.8
Denmark	6.2	3.3	3.0
France	6.3	0.1	−2.6
Germany	8.8	0.3	0.1
Japan	9.3	1.3	−0.3
The Netherlands	7.7	1.5	0.8
Spain	5.8	1.9	0.6
Sweden	9.9	3.1	2.2
U.K	7.6	2.3	1.2
U.S	8.7	2.1	1.0

Source: Dimson, et al. (2002)

the right as the time horizon lengthens. In other words, the mathematical expected cumulative return is less likely to be realized in the future than the median return.

The variance of returns measures is a measure of risk. Another measure of variability is the square root of the variance – the standard deviation. Note that the distribution of returns shown in Exhibit 4.1 is normal, that is, the upside potential and downside risk are of same magnitude. Returns from securities, in real-life situations, may not be normal. We assume normality to simplify analysis.

One good thing about normal distribution is that it can be described with only two parameters: mean and standard deviation. The standard deviation captures both upside potential and downside risk. But the investor is considered with only the former. The downside risk is simply half the total variability. So measuring standard deviation serves our purpose. The annualized real returns on equities, bonds, and bills in different countries are presented in Exhibit 4.4.

Notice that equities have outperformed bonds and bills in virtually every country. The return on T-bills, 5-year treasuries, 20-year treasuries, large stocks, and small stocks in the United States for the period 1926–1998 is presented in Exhibit 4.5.

Exhibit 4.5 Annual return and risk of US stocks, bonds and bills for the period 1926–2000

Asset	Annualized return	Standard deviation
1 yr T bill	3.9	3.2
Long term Govt bonds	5.7	9.4
Long term corporate bonds	6.0	8.7
Large stocks	13.0	20.2
Small stocks	17.3	33.4

Source: Ibbotson Monograph - Stocks, Bonds, Bills and Inflation 2001 Year book

The annual (large) stock returns in the United States were 13.0% vs 5.7% for long-term T-bonds and 3.9% for bills. That is not the end of the story. The standard deviation of annual stock returns is usually more than that for bonds or bills, which suggests that returns are in line with risk.

4.4 Types of Risk

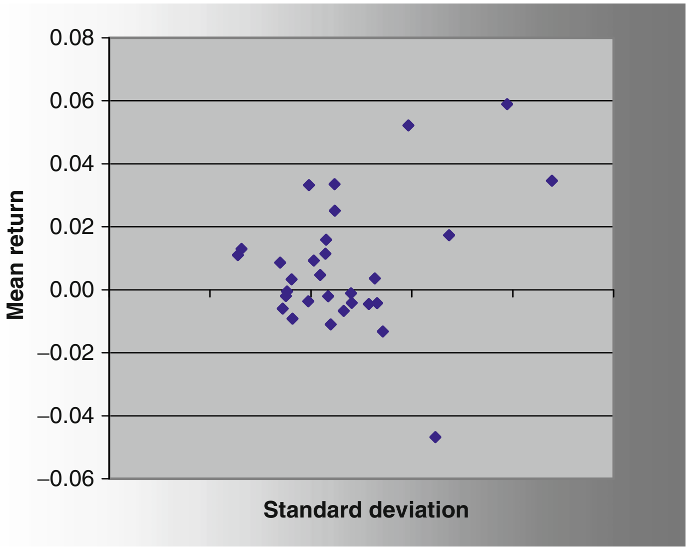
The above data suggest that the riskier the asset class, the greater is the return. The argument is that investors are compensated with a risk premium for holding riskier securities. This relation does not hold true for the index stocks. A scatter plot for the Bombay Stock Exchange (BSE) Sensitive Index stocks is displayed in Exhibit 4.6.[2] This scatter plot indicates a negative relationship between the mean monthly return and standard deviation of stocks in the BSE Sensitive Index, as would be suggested by the risk premium hypothesis. Some of the risk investors assume is specific to the individual stocks in their portfolio – for example, a company's earnings may come down due to a strike. On the contrary, because stock prices and returns move in tandem to some extent, even investors holding widely diversified portfolios are exposed to the risk inherent in the overall performance of the stock market. So, the security's total risk can be divided into *unsystematic risk*, the portion specific to the company or a small group of assets, which can be diversified away, and *systematic risk*, the nondiversifiable portion that is related to the movement of the stock market.

$$\text{Total risk} = \text{Unsystematic Risk} + \text{Systematic Risk}.$$

Examples of unsystematic risk factors are a lower-cost foreign competitor unexpectedly enters a company's product market or a labour unrest disrupting production in the company. Examples of systematic risk factors are increase in long-term interest rates, a central bank stepping up its restrictive monetary policy.

[2] The BSE Sensex has 30 stocks that account for 80% of market capitalization. This exercise can be replicated for any market (proxied by the respective index).

Exhibit 4.6 Risk and return of Bombay Stock Exchange Sensitive Index 30



4.5 Measuring Portfolio Risk

The risk of a portfolio of securities is *not* the sum of variances of returns of individual securities. To demonstrate risk in a portfolio context, consider a primitive economy where there are only two firms – one makes umbrella and the other, suntan lotion. Let us suppose that the returns from these two stocks follow a cyclical pattern as shown in Exhibit 4.7.

The return from holding shares of both companies is the weighted average of returns from the two stocks.

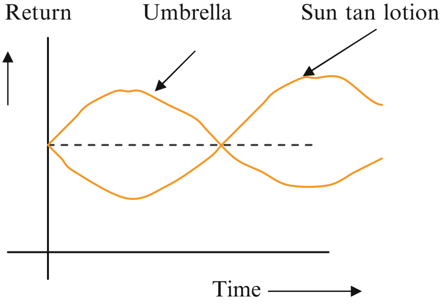
$$R_p = \sum_{i=1}^{n} X_i R_i, \tag{4.5}$$

where X_i = proportion of money invested in asset i, R_i = expected return of asset i.

But the risk of the portfolio is not the sum of individual variances. It would be smaller than that of holding individual stocks. As shown in the diagram above, the investor is *assured* of return R (*the dashed horizontal line*); however, volatile individual stocks may be. This happens because of negative correlation between the returns. The returns from stock exactly counterbalance the returns from the other stock. As the cliché goes, not putting all eggs in one basket reduces risk. But is this always so? A moment's reflection tells us that it is not true. When stock returns are perfectly positively correlated, losses can coincide. So, diversification does not reduce risk in this case.

We established the fact that diversification reduces risk. But you need to know how. To illustrate risk in a portfolio context, consider two stocks. Assume that the expected annual returns are 21.48% and 16.56%, respectively. Suppose that you invest 60% of your initial investment in the first and 40% in the second.

Exhibit 4.7 Returns from counter cyclical stocks



$$\text{Expected Portfolio Return} = (0.6 \times 21.48) + (0.4 \times 16.56),$$
$$= 19.5\%.$$

The standard deviation of past returns is 18% and 27%, respectively. The portfolio variance is *not* the weighted average of individual variances.

Portfolio variance

$$\sigma_{\mathrm{p}}^2 = (X_1^2 \times \sigma_1^2) + (X_2^2 \times \sigma_2^2) + (2X_1 \times X_2 \times \mathrm{Cov}_{12}), \tag{4.6}$$

where X_1 = proportion of money invested in stock 1; X_2 = proportion of money invested in stock 2; σ_1 = standard deviation of returns from stock 1; σ_2 = standard deviation of returns from stock 2.

The portfolio standard deviation is the square root of (4.6). Note the third term in the equation. Covariance is a measure of the extent to which the two stocks covary. A positive covariance suggests that the returns (*prices*) move in the same direction and a negative covariance indicates that prices move in opposite direction most of the time.

$$\mathrm{Cov}(1,2) = \rho_{12} \times \sigma_1 \times \sigma_2,$$

where ρ_{12} is the correlation coefficient

Three situations suggest themselves.

Situation 1: The stock returns are perfectly positively correlated, that is, ρ_{12} is 1.

$$\sigma_p^2 = (0.6 \times 18)^2 + (0.4 \times 27)^2 + 2 \times 0.6 \times 0.4 \times 1 \times 18 \times 27,$$
$$= 466.56,$$
$$\sigma_p^2 = 21.6\%.$$

Situation 2: $\boldsymbol{\rho_{12}}$ **is** -1

$$\sigma_p^2 = 116.64 + 116.64 - 233.28 = 0.$$

Yes! The portfolio variance is 0. But, it is unlikely that you will find perfectly negatively correlated stocks in real life.

Situation 3: ρ_{12} is less than 1 (say 0.5)

$$\sigma_p^2 = 349.92,$$
$$\sigma_p = 18.7\%.$$

Negative or less than perfect correlation (covariance) reduces the risk of the portfolio, positive covariance does not.

We have arbitrarily chosen 60% and 40% as weights. Suppose we alter it to 50% and 50%. Let ρ_{12} be 0.3

$$\begin{aligned}
\sigma_p^2 &= (0.5 \times 18)^2 + (0.5 \times 27)^2 + 2 \times 0.5 \times 0.5 \times 0.3 \times 18 \times 27, \\
&= 336.15, \\
\sigma_p &= 18.3\%, \\
E(R_p) &= (0.5 \times 21.48) + (0.5 \times 16.56), \\
&= 19.02\%.
\end{aligned}$$

We can construct a large number of portfolios with different weighting schemes. But, is there one best portfolio that minimizes portfolio variance?

$$\begin{aligned}
\sigma_p^2 &= X_1^2 \times \sigma_1^2 + X_2^2 \times \sigma_2^2 + 2X_1 \times X_2 \times \mathrm{Cov}_{12}, \\
&= X_1^2 \times \sigma_1^2 + (1 - X_1)^2 \times \sigma_2^2 + 2X_1 \times (1 - X_1) \times \rho_{12} \times \sigma_1 \times \sigma_2.
\end{aligned}$$

Differentiating the above equation with respect to X_1 and equating to zero

$$\delta\sigma_p^2/\delta X_1 = 2X_1 \times \sigma_1^2 + (2X1 - 2)\sigma_2^2 + 2\rho_{12} \times \sigma_1 \times \sigma_2 - 4X_1\rho_{12} \times \sigma_1 \times \sigma_2 = 0.$$

Solving for X_1

$$X_1 = \frac{[\sigma_2^2 - \rho_{12} \times \sigma_1 \times \sigma_2]}{[\sigma_1^2 + \sigma_2^2 - 2\rho_{12} \times \sigma_1 \times \sigma_2]}.$$

In the above example,

$$\begin{aligned}
\sigma_1 &= 18\%, \\
\sigma_2 &= 27\%, \\
\rho_{12} &= 0.3.
\end{aligned}$$

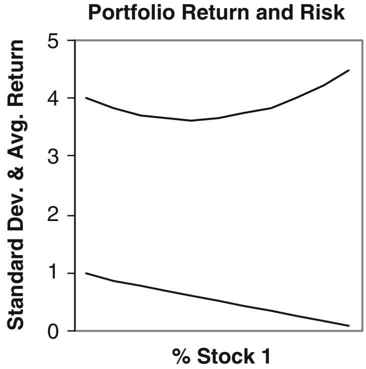
On substitution we get $X_1 = 76\%$ and X_2 $(= 1 - X_1) = 24\%$.

In short, to compute portfolio risk, you (1) collect return variances and covariances in a table – the "covariance matrix"; (2) read in the portfolio holdings weights; and (3) apply the portfolio risk formula.

4.5.1 An Illustration

Exhibit 4.8 presents the average portfolio (weekly) return and standard deviation for various compositions of two stocks. The correlation between the returns from the two stocks is 0.5. The portfolio variance is the least when 60.40% of the money is invested in the first stock. The portfolio variance decreases at a faster rate than the portfolio return in line with our expectation.

Exhibit 4.8 Portfolio return and risk



Stock 1	Stock 2	Std. Deviation %	Portfolio return %
100%	0%	4.012	0.974
90	10	3.848	0.884
80	20	3.728	0.794
70	30	3.654	0.704
60	40	3.63	0.614
50	50	3.657	0.524
40	60	3.734	0.433
30	70	3.857	0.343
20	80	4.023	0.253
10	90	4.227	0.163
0	100	4.463	0.073

3 asset and N asset portfolios

	1	2
Average weekly return %	0.974	0.073
Standard deviation %	4.012	4.463
Covariance	8.743	
Correlation coefficient	0.0493	

4.6 Estimating the Covariance Matrix

Looking forward, to estimate prospective portfolio risk, we need estimates of the variances and covariances. We need an estimate of the covariance matrix. How can we get it? One method is to treat each asset independently and use some simple volatility estimator – combinations thereof (Garman-Klass 1980), or even GARCH estimators (Engle 1982; Bollerslev 1986).[3] For assets with traded volatility markets, that is, option markets, we could even take the market forecasts implied by option prices "implied volatility"[4]. Whatever we choose though, each asset is treated in isolation. The only data used in the estimate is that asset history. Likewise for the covariance: for any stock pair, we can use the classical covariance between the two assets. They are wasteful and inaccurate. Worst of all, there is no underlying theory. They are purely data-driven. And indeed their shortcomings do show: covariance matrices built in this way are misleading. Consequently, some academics have come up with competing theories of asset pricing. These are discussed in the subsequent sections.

The variance of a three asset portfolio can be written as follows:

$$\begin{aligned}\sigma_p^2 = {} & X_1^2 \times \sigma_1^2 + X_2^2 \times \sigma_2^2 + X_3^2\sigma_3^2 + 2X_1 \times X_2 \times \mathrm{Cov}_{12} + 2X_2 \times X_3 \times \mathrm{Cov}_{23} \\ & + 2X_1 \times X_3 \times \mathrm{Cov}_{13},\end{aligned}$$

where X_i are weights; σ_i^2 are variances.

Similarly, for an N asset portfolio:

$$\sigma_p^2 = \sum\sum X_i X_j \sigma_I \sigma_j \sigma_{ij}.$$

There are gains from diversification. But, how large should the portfolio be? In other words, how many stocks should an investor hold before marginal costs exceed marginal benefits of diversification? As the number of assets in the portfolio increases, the variance of the portfolio approaches the covariance or the average systematic risk of the stocks, that is, unsystematic risk is diversified away. The marginal benefits from diversification diminish beyond a certain limit. Most textbooks conclude that 10–12 stocks are adequate to reap the benefits of diversification. The marginal costs (like transaction and information costs) offset the gains from diversification thereafter. Statman (1987) proves that for a borrowing investor at least 30 stocks are required and for a lending investor at least 40 stocks are required.

When one plots the distribution of historical returns of a diversified portfolio (of, say, 100 stocks) and compares it with the distribution of returns of a single security, one finds that the standard deviation of returns of a single stock is much more than that of the portfolio; yet the average return of the stock is lower than that of the portfolio. What does this imply? Does the market not reward the higher risk of a stock with higher returns? The answer lies in the benefits of diversification.Realized returns will be more in line with *systematic* risk rather than *total* risk. Wagner and Lau (1971) divided 200 New York Stock Exchange (NYSE) stocks into 6 subgroups based on S&P stock quality rating (from highest to lowest); randomly selected portfolios from each of the subgroups containing from 1 to 20 stocks. Exhibit 4.9

[3] ARCH and GARCH (Generalized Auto regressive Conditional Heteroscedasticity) are beyond the scope of this book. Interested readers may refer to econometrics texts for more information.

[4] Given the option price and all other factors (like time to maturity, stock price, exercise price, etc) that determine option prices, one can estimate the value of standard deviation in the Black-Scholes formula for pricing options by trial and error. This value is termed "implied volatility."

Exhibit 4.9 Effect of diversification on risk

No. of stocks	Avg. monthly return (%)	S.D. % per month
1	0.88	7.0
2	0.69	5.0
3	0.74	4.8
4	0.65	4.6
5	0.71	4.6
10	0.68	4.2
15	0.69	4.0
20	0.67	3.9

presents the average monthly returns and standard deviation for the first subgroup. It can be seen that although average return is unrelated to the number of stocks in the portfolio, the standard deviation declines as the number of stocks increases. Almost 40% of risk can be eliminated by holding 20 stocks.

4.7 Risk and Return: The International Evidence

Broadly, financial markets around the world can be classified as developed or emerging. Emerging markets typically yield higher returns. But their standard deviation is higher as well. Exhibit 4.10 presents the mean returns and standard deviation of returns around the world. International investors have the option of investing in securities from around the world. A major argument for investing internationally is that it increases profit opportunities while providing risk diversification. Just as investors can diversify away unsystematic risk by holding a portfolio of stocks, they may also benefit from international diversification. As long as there are benefits from international diversification, a portion of what seems to be systematic risk in a domestic context may be diversifiable country risk at a global level. If markets are completely integrated there would be no benefit from international diversification (Solnick 1974).

Although the tendency of markets to move together has increased in the recent years, the correlation is still less than 1 (see Exhibit 4.11). So, there are still opportunities to reduce risk. In other words, portfolios may be formed out of stocks from many countries to reduce risk further. As an assignment construct, an equal value weighted portfolio of Japan and Germany.

4.8 Markowitz Model

Modern portfolio theory (MPT) is based on the premise that an investor chooses from all possible investments on the basis of expected portfolio return and portfolio variance. If an investor is rational, she/he will choose that investment which

Exhibit 4.10 Characteristics of emerging and developed markets

Country	MktCap $ m Sep 1995	Std. Deviation %	Mean return annualized %
Emerging markets			
Argentina	18,783	93.1	42.0
Brazil	106,821	64	33.1
Colombia	9,079	31.4	39.7
India	66,772	29.5	17.4
Indonesia	26,995	30.8	3.3
Mexico	65,585	46.5	20.8
Philippines	32,829	37.4	42.9
Developed markets			
Australia	137,352	26.6	15.1
Canada	193,156	19.6	9.7
Germany	344,087	22.4	14.1
Japan	2,050,510	25.1	17.8
Switzerland	285,171	19.2	14.2
U.K	842,965	21.5	16.4
U.S	3,540,304	15.0	14.8

Source: Erb et al. (1996)

Exhibit 4.11 Global correlations

	U.S.	U.K	Japan	France	Germany	Canada
U.S	–	0.45	0.19	0.28	0.39	0.59
U.K	0.53	–	0.21	0.22	0.24	0.36
Japan	0.40	0.37	–	0.15	−0.02	0.14
France	0.38	0.24	0.36	–	0.31	0.23
Germany	0.42	0.39	0.31	0.32	–	0.39
Canada	0.60	0.33	0.21	0.45	0.19	–

Source: Paul, (n.d.)

provides the highest return for a given level of risk or the least risky investment for a given level of return. Thus, these *efficient* portfolios dominate other combinations. The curved line that connects all the efficient portfolios is called efficient frontier. Exhibit 4.12 depicts an efficient frontier. A range of weights from 0% risky asset one (i.e. 100% risky asset two) to 100% risky asset two (0% risky asset two) is also used. Since there are only two assets in the portfolio, the weight of the second risky asset is a dependent value equal to 100% minus the weight of risky asset one.

Investment B is superior to A as it offers higher return for the same level of risk. Similarly, Investment C is superior to A as it offers the same return for lower level of risk. But, how does an investor choose among the efficient portfolios? That depends on the risk taking ability of the investor.

Exhibit 4.12 Efficient frontier

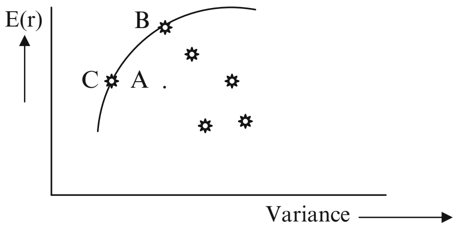
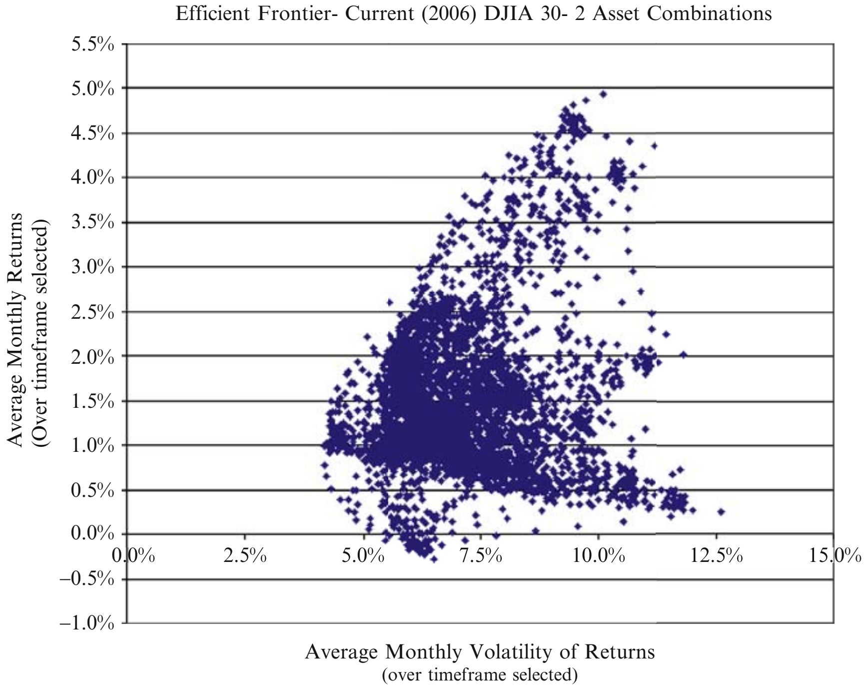


Exhibit 4.13 Efficient frontier constructed out of DJIA stocks. Source: FE News



Source: FE News

But, we all know the investment universe consists of many, many more than two risky assets. Given the complete range of risky investments out there (stocks, bonds, real estate, commodities, etc.), one challenge is defining what this investment universe is. The second challenge, once you define it how do you calculate the efficient frontier for your selected investment universe?

Exhibit 4.13 shows the estimation of efficient frontier calculated using the DJIA (Dow Jones Industrial Average) 30 stocks using two stocks at a time (for the period the index has lasted). Similar exercise can be done for more stock combinations (3, 4, 5, etc.).

To calculate the variance of a two stock portfolio, we need individual variances and correlation between the stock returns. As the number of assets in the portfolio increases, the number of inputs increases considerably. For an N asset portfolio, we would need $N(N-1)/2$ correlation estimates. This is the drawback of the Markowitz model.

The CAPM is an extension of Markowitz portfolio theory. The Markowitz technique involves too many calculations. The CAPM, on the contrary, tries to correlate the returns from the stock with a market index rather than with other stocks. For instance, for a portfolio of 30 stocks, we would have calculated 30 standard deviationss and $30 \times 29/2$ correlations under the Markowitz technique, but only 30 standard deviation and 30 correlations with the market under the latter technique. Both the methods help delineate efficient portfolios. The beauty is that both give same results.

4.9 Portfolio Optimization in Practice

Business Spreadsheets (formerly Excel Business Tools), for example, provides purpose built Excel templates that can be quickly applied to a range of financial analysis and business decision-making scenarios. All Excel templates function with Microsoft Excel 97 or higher, including Excel 2004 for Mac. The portfolio optimization template calculates the optimal capital weightings for a basket of investments that gives the highest return for the least risk. The unique design of the template enables it to be applied to either financial instrument or business portfolios.

Key features of the portfolio optimization template include

- Ease and flexibility of input, with embedded help prompts.
- Specify minimum and maximum constraints for the optimized portfolio.
- Unique "Maintain Current Return Level" option to ensure that return is not deteriorated at the expense of risk.
- Ability to modify the correlation matrix and the portfolio dynamics before the optimization process.
- Intuitive graphical result display with Monte Carlo simulation, including probability analysis on specified "Target" return level.

The Excel templates of input and output required/provided by the Business Spreadsheets software are displayed in Appendices 1–3 (at the end of the chapter).

It is also possible to use the Solver program to determine the per cent of available funds to invest in each stock.[5] The resulting portfolio is the optimal portfolio. The variances, covariances and mean returns are calculated from a history of stock

[5] www.solver.com. Several excellent texts on Excel Modeling are available. See, for example, Holden, Craig, Excel Modeling in Investments, Second Edition, Pearson/Prentice Hall, 2004. The steps involved in building a spreadsheet model are outlined in http://www.spreadsheetmodeling.com a website maintained by Prof Craig Holden.

prices. A Visual Basic program uses the Solver to optimize the Markowitz model for several different target rates of return.

Assume that an investor has to allocate capital among five stocks. Further assume that the returns, standard deviations and covariances of the five stocks are known. The variables are the percentage allocations to five stocks. The constraints are as follows:

- Allocations are ≥ 0
- Total portfolio $= 1$
- Portfolio return $\geq$ target (say, 9%)

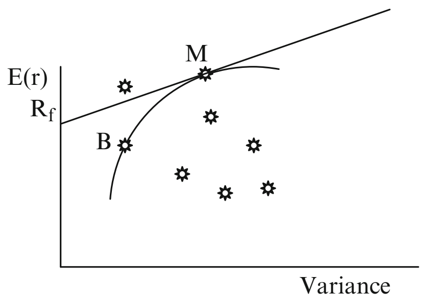
The objective is to minimize portfolio variance. The solver program provides the portfolio allocation given the objective and constraints.

4.10 Introducing Risk-Less Lending

Markowitz's work established that a mean-variance efficient frontier exists for any collection of risky assets and rational investors should only select portfolios "on this frontier" at a position that reflects their personal risk preferences and tolerances. The introduction of a risk-free (zero variance of returns) asset added a new dimension to this analytical framework, giving investors an additional investment option: Select their optimal portfolio of risky assets along the efficient frontier and blend this portfolio in various proportions or weights with an investment in the risk-free asset.

Suppose an investor has identified an efficient portfolio. Let us call it M. Further, the investor has the opportunity to invest in a risk-free asset. She/he can choose to invest in M or in the risk-free asset or in some combination. We can think of investing in risk-free asset as lending at risk-free rate (buying Government securities). So, the investor can take any position on the line $R_f - \mathrm{M}$ as shown in Exhibit 4.14. Note that the line is tangential to the efficient frontier meaning that the portfolio M gives the highest return per unit of risk.

Exhibit 4.14 Capital market line



All the points on the line R_f M are combinations of investment in risk-free asset and M. You might be wondering how or why this risk-free asset is significant. Let us go back to the two stock portfolio case.

$$\sigma_p^2 = X_1^2 \times \sigma_1^2 + X_2^2 \times \sigma_2^2 + 2X_1 \times X_2 \times \mathrm{Cov}_{12}, \tag{4.7}$$

where X_1 = proportion of money invested in risk-free asset; X_2 = proportion of money invested in portfolio M; σ_1 = standard deviation of returns from risk-free asset; σ_2 = standard deviation of returns from M.

By definition, the variance of returns from risk-less asset is 0 and the returns do not covary with the returns from other assets. So the first and the last terms become 0.

$$\begin{aligned} \sigma_p^2 &= X_2^2 \times \sigma_2^2, \\ &= (1 - X_1)^2 \times \sigma_2^2. \end{aligned}$$

As is evident, by investing partly in a risk-free asset, the investor can reduce the risk further. Given a chance to invest in a risk-less asset, an investor would always hold a combination of R_f and M and not an efficient portfolio alone. The combinations yield higher returns for the same level of risk as shown in Exhibit 4.14. In short, the efficient frontier has been transformed into a straight line.

The tangency portfolio *had* to be the market portfolio; one containing the universe of *all* risky assets. Why? Because this was a portfolio *every* rational investor would hold; if a risky asset was not included in this portfolio there would be no demand for it and it would not exist. As for the proportion of each risky asset in this market portfolio, market efficiency and equilibrium dictate that demand for each asset would be reflected in its price so that the relative market capitalization of each asset (as a percentage of the entire market for risky assets) would be the weight or proportion of each asset in the market portfolio.

What could be the *composition* of M? If the investor has superior information vis-à-vis other investors in the market, then M is that portfolio which offers superior returns for its risk level (i.e. the portfolio is undervalued). Otherwise, it is that portfolio which any other investor can hold. The logical limit is to include all risky assets in the economy. The portfolio of all risky assets is called the market portfolio. Since the market portfolio is unobservable, a market index such as the BSE 30 index is taken as a proxy. The line joining R_f and M is called capital market line.

4.11 Deriving the Capital Market Line

The expected return of a portfolio consisting of the risk-free asset and M,

$$R_{\mathrm{p}} = X_1\ R_{\mathrm{f}} + X_2 E(R_{\mathrm{M}}) \ldots. \tag{4.8}$$

That is,

$$\begin{aligned} R_{\mathrm{p}} &= (1 - X_2)R_{\mathrm{f}} + X_2 E(R_{\mathrm{M}}), \\ &= R_{\mathrm{f}} + X_2[E(R_{\mathrm{M}}) - R_{\mathrm{f}}] \ldots. \end{aligned} \tag{4.9}$$

We know that

$$\sigma_{\mathrm{p}}^2 = X_2^2 \times \sigma_{\mathrm{M}}^2,$$

or

$$\sigma_{\mathrm{p}} = X_2 \times \sigma_{\mathrm{M}},$$

i.e.,

$$X_2 = \frac{\sigma_{\mathrm{p}}}{\sigma_{\mathrm{M}}}.$$

Inserting in (4.9)

$$= \frac{R_{\mathrm{f}} + \sigma_{\mathrm{p}}}{\sigma_{\mathrm{M}}[E(R_{\mathrm{M}}) - R_{\mathrm{f}}]}.$$

This is the equation for the capital market line (CML). The slope of the line is given by

$$= [E(R_{\mathrm{M}}) - R_{\mathrm{f}}]/\sigma_{\mathrm{M}}.$$

This is the market risk premium.

An important consequence of MPT is that the only meaningful aspect of total risk to consider for any individual asset is its contribution of risk to the total risk of a portfolio. What capital market theory and the CML contributed to MPT was the demonstration that only *one* investment portfolio mattered in evaluating the portfolio risk contribution characteristics of any asset, and it was the market portfolio consisting of *all* risky assets in proportion to their market capitalization. And by this definition of the market portfolio, entirely inclusive of all meaningful risky assets in their most efficient relative proportions, it was a fully diversified portfolio. The inherent risk of each asset that *could* be eliminated by belonging to the market portfolio *had* been eliminated. Only market risk remained, also called systematic risk. In other words, the benefit of risk reduction defined by MPT had reached its ultimate limit.

4.12 The Capital Asset Pricing Model

The CAPM is a model for risky asset pricing (i.e., defining an appropriate risk-adjusted required return for any risky asset in relation to every other risky asset) that is built on these insights. Because every risky asset belongs to the market portfolio, the only aspect of total risk that matters to investors is the asset's contribution of risk to the market portfolio, or said differently, its contribution to the market portfolio's systematic risk. Using a statistical technique called linear regression, based on the concepts of ordinary least squares (OLS), the total risk of each risky asset is separated into two components – the variability in its returns (i.e., risk) that is perfectly correlated with the variability of returns in the market portfolio (its contribution to systematic risk) and the variability in returns that is perfectly uncorrelated with the variability of returns in the market portfolio (called unsystematic risk).

It was pointed out earlier that the total risk consists of two components: systematic and unsystematic risk. Unsystematic risk can be diversified away by holding a portfolio of securities; what remains is the systematic risk. As well-diversified investors are exposed to only systematic risk, the relevant risk in a CAPM universe is the systematic risk. Beta (β) is the standard measure of systematic risk. It measures the tendency of the returns of a security to move in line with the stock market as a whole. Beta gauges the sensitivity of security returns vis-à-vis market returns. A stock with a beta of 1.0 rises and falls at the same percentage as the market. Stocks with a beta greater than 1.0 (aggressive stocks) tend to rise and fall by a greater percentage than the market. That is they are very sensitive to market swings. Stocks with beta less than 1.0 (defensive stocks) are less sensitive to market swings. The market, by definition, has a beta of 1.0.

$$\text{Beta} = \frac{[\text{Cov}\, R_\text{j}, R_\text{m}]}{\sigma_\text{M}^2}.$$

4.13 Security Market Line

The CAPM establishes the relationship between risk and expected return. In a CAPM world, securities are priced such that

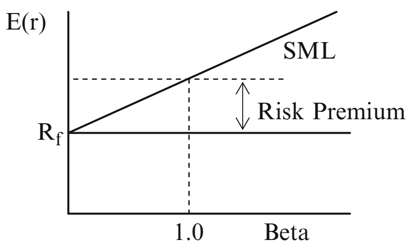
$$R_\text{j} = R_\text{f} + \text{risk premium},$$
$$R_\text{j} = R_\text{f} + \beta[E(R_\text{M} - R_\text{f})].$$

This relationship between risk and expected return is called the security market line (SML) (see Exhibit 4.15). The risk premium of a security is a function of the risk premium on the market, $R_\text{M} - R_\text{f}$, and varies directly with beta. The higher the beta, the higher the expected return

$$\text{Expected return} = E(R) = R_\text{f} + \text{Amount of risk} \times \text{Market price of risk}.$$

In a financial market described by CAPM, no security can sell for long at prices low enough to yield more than its appropriate return on the SML. The security would then be very attractive compared with other securities of similar risk and investors would bid its price up until its expected return fall to the appropriate position on the

Exhibit 4.15 Security market line



SML. Conversely, investors could sell off any stock selling at a price high enough to put its expected return below its appropriate return. To reiterate, security return can be divided into components: one dependent and the other independent of market return.

$$\text{Security return} = \text{Systematic return} + \text{Unsystematic return}.$$

Systematic return can be measured by multiplying the market return and the beta of the stock.

The CAPM is based on certain assumptions

- Investors make choices on the basis of risk (i.e. variance) and return
- Asset returns are distributed by the normal distribution
- Investors have homogeneous expectations of risk and return
- Investors have identical time horizons
- Information is freely available to investors
- There is a risk-free asset and investors can borrow and lend at risk-free rate
- There are no taxes or transaction costs or restrictions on short selling
- The true market portfolio defined by the theory behind the CAPM is unobservable. You will have to select and use a market portfolio "proxy."

An example is in order. The expected market return is 14% and the risk-free rate is 5%. What would be the expected return on a stock with $\beta = 0$? It would be 5%, same as the risk-free rate. What would be the expected return on a stock with $\beta = 1$? It would be 14%, same as the market return. What would be the expected return on a portfolio made up of 50% T-Bills and 50% market portfolio? It would be 9.5%, the weighted average of returns, weights being money invested (i.e., 50%).

4.14 Do Individual Investors Hold Diversified Portfolios?

Studies conducted in America indicate that typical investor's stock portfolio contains only a small fraction of the available securities and the number of stocks in a portfolio range from 9 to 12. Why do investors forgo the benefits of diversification? Is it because they do not know the benefits of diversification? What does under-diversification imply for pricing of risky financial assets? Some academicians observe that due to under-diversification even unsystematic risk may be priced in markets. Investors might not hold diversified portfolios; it is enough if they price securities as though they are diversified. This reinforces CAPM.

4.15 Is There a Risk-Free Asset?

Investors hold assets in anticipation of returns from them. The actual return may deviate from the expected return. The variance in actual return from the expected is the risk in holding that asset. For an asset to be risk free, the actual return from the asset should always equal the expected return. For instance, an investor may buy a

T-bond that promises to pay 12%. Since sovereign governments are usually free of default risk, the actual return will be 12%. For an asset to be classified as risk free, the first qualification is that it should be free of default risk. Even the highest rated companies will have some default risk in them. This precludes them from being classified as risk free. The second qualification is that the asset should not have any reinvestment risk. Reinvestment risk arises from reinvesting coupon payments at rates below that prevailed at the time of buying. To illustrate, if interest rates decline from 10% to 8% after buying, the investor can reinvest coupon payments only at 8%. So, he will not realize the YTM promised at the time of issue. For this reason, even treasury securities cannot be considered risk free.

4.16 Some Observations on Risk Premium

The risk premium, $R_m - R_f$, is usually estimated by looking at the historical premium earned by stocks over government bonds over long periods (over 60 years in the case of United States). In India, however, due to non-availability of data, 18-year period is used.[6] The historical risk premium is used as proxy for future.

Exhibit 4.16 presents the risk premium for countries around the world.

Some countries have low and some countries have negative risk premium. What factors affect risk premium? Why are risk premium so high in some countries? Can we expect future premium to be high as well? Can we predict short term (say, one month) and long term (say, 30 years) of equity premium?

Several factors (such as the following) might affect risk premium.

Exhibit 4.16 Risk premium for select countries

Country	Annual equity return (%)	Bond return (%)	Risk premium (%)
Australia	8.47	6.99	1.48
Canada	8.98	8.30	0.68
France	11.51	9.17	2.34
Germany	11.30	12.10	−0.8
Italy	5.49	7.84	−2.35
Japan	15.73	12.69	3.04
Singapore	15.48	6.45	9.03
Hong Kong	20.39	12.66	7.73
Switzerland	13.49	10.11	3.38
U.K.	12.42	7.81	4.61

[6] As on the date of the book.

4.16.1 Extent of Globalization

Because of increasing globalization of companies, the reliance on any one nation is decreasing leading to reduced sensitivity of economies and hence systematic risk. The flip side is that, because of increasing mobility of capital across national boundaries stock markets are increasingly getting integrated. Because of integration of capital markets, volatility in one market gets propagated to other countries as demonstrated in the Asian financial crisis.

4.16.2 Market Sophistication

Individuals now invest in stock markets through professional investors like mutual funds. Fund managers, as informed investors, are better equipped to assess and manage risk. Consequently, stock market volatility in sophisticated markets is usually lower than underdeveloped capital markets.

4.16.3 Shareholder Activism

The pressure on managers to increase shareholder value is increasing. One way to increase value is to reduce systematic risk.

4.16.4 State of the Stock Market

Larger stock markets such as the US market are more liquid, less volatile and hence less risky. The less developed markets like Latin American markets are more volatile and risky.

4.16.5 Risk of Stocks Relative to Bonds

Over time the risk of investing in stocks may decrease while the risk of investing in bonds may increase, thereby reducing risk premium. Since equity premia occupies an important place in modern finance theory, academicians are struggling to devise a method to estimate future premia.[7] Academic studies indicate that a simple regression predicting equity premia 1 year ahead with dividend yields works quite well.

---

[7] See Campbell, John and Robert Shiller, "The Dididend-Price Ratio and expectations of future dividends and discount factors, Review of Financial Studies, 1988, v1(3), Fama, Eugene and Kenneth French, "Dividend yields and Expected stock returns, Journal of Financial Economics, 1988, v22(1).

4.17 Arbitrage Pricing Theory

CAPM is based on the concept of diversification. By holding sufficient number of stocks, an investor can diversify company-specific risk. Even if the investor were to hold all stocks in the market, she/he will still be exposed to market risk. The arbitrage pricing theory (APT) a competitor to CAPM, suggests that a small number of systematic factors affect the long-term returns of securities and the beta alone does not explain differences in security returns (Roll and Ross 1985). Consider 2 portfolios – one consisting of financial services companies stocks and the other, food products companies stocks. Would you expect both the portfolios to react in the same manner to rising interest rates and inflation? Obviously we would not. Financial services companies are more sensitive to increase in interest rates. The betas of the portfolios may be the same, but investors may not expect the average returns from these portfolios to be the same due to their differential sensitivity to macroeconomic factors. The APT tries to capture these significant factors. The trick is to incorporate multiple sources of economic risk by having more than one beta. Each beta (called factor beta) measures the sensitivity of the stock to the corresponding factor. The APT model does not tell us what those factors are. It assumes that the investor knows which systematic factors affect stock returns.

The investor can construct his/her model unlike in CAPM where the beta is thrust upon us.

The APT model can be written as

$$\begin{aligned}\text{Expected return} = \text{Risk free rate} &+ [(\text{sensitivity to factor 1}) \times (\text{risk premium on factor 1})] \\ &+ [(\text{sensitivity to factor 2}) \times (\text{risk premium on factor 2})] + \cdots,\end{aligned}$$

$$E(R) = R_f + \beta_1[E(R_{M1} - R_f)] + \beta_2[E(R_{M2} - R_f)] + \cdots.$$

If the stock market index is the sole factor explaining security returns, we would get back to our CAPM. Studies in America have shown that about 5–6 factors affect US stock prices. One important study by Chen, Roll and Ross suggests that growth in industrial production, unexpected changes in the term structure of interest rates, spreads between high and low grade bond portfolio returns and unexpected inflation determine security returns.

Assume that a portfolio's returns are dependent on two factors – say, industrial production and inflation. Any unexpected change in the industrial production from current levels would change the expected returns in the same direction while changes in inflation from current levels would change expected returns in the *opposite* direction. Assume that there are four stocks whose returns and sensitivities are as follows[8]:

[8] Bower et al. (1992).

Stock	Exp. Ret. %	Prod. Sensitivity	Inflation Sensitivity
1	13	0.2	2.0
2	27	3.0	0.2
3	16	1.0	1.0
4	20	2.0	2.0

This is not possible because one can buy the first two stocks and short sell the remaining stocks (so investment is zero) and still generate a positive return. This cannot happen in competitive markets. To construct an arbitrage portfolio, the following equations must be satisfied:

(1) INV 1 + INV 2 + INV 3 + INV 4 = 0, that is, no investment
(2) INV 1 [Sensitivity (P)1] + INV 2 [Sensitivity (P) 2] + INV 3 [Sensitivity (P) 3] + INV 4 [Sensitivity (P) 4] = 0, that is, no production risk
(3) INV 1 [Sensitivity (I) 1] + INV 2 [Sensitivity (I) 2] + INV 3 [Sensitivity (I) 3] + INV 4 [Sensitivity (I) 4] = 0, that is, no inflation risk

Set the level of investment in Stock 1 at $ 1 and solve for the rest.

INV 1 = $1
INV 2 = $0.624857
INV 3 = $− 1.157143
INV 4 = $− 0.485714

The arbitrage portfolio would be as follows:

Stock	INV	Exp. Ret. INV × Expret.	Prod. Sens. INV × Sensit. (*P*)	Infl. Sens. INV × Sensit. (*I*)
1	1.0	13.0	0.20	2.0
2	0.643	17.361	1.929	0.129
3	−1.157	−18.512	−1.157	−1.157
4	−0.486	−9.720	−0.972	−0.972
	0	2.129	0	0

The activity of buying the first two stocks will drive up their prices and bring their returns in line with their sensitivities. Similarly, short selling the remaining will drive down their prices. In other words, arbitrage will bring returns of stocks to their equilibrium levels. The factors that affect security returns themselves are identified through factor analysis.

4.18 Capital Asset Pricing Model vs Arbitrage Pricing Theory

APT is a valuation model. Compared to CAPM, it uses fewer assumptions but is harder to use. The basis of APT is the idea that the price of a security is driven by a number of factors. These can be divided into two groups: macro factors and company specific factors. The name of the theory comes from the fact that this division, together with the no arbitrage assumption, can be used to derive the following formula:

$$r = r_{\mathrm{f}} + \beta_1 f_1 + \beta_2 f_2 + \beta_3 f_3 + \cdots,$$

where r is the expected return on the security; r_f is the risk-free rate; each f is a separate factor and each β is a measure of the relationship between the security price and that factor.

This is a recognizably similar to CAPM.

The difference between CAPM and APT is that CAPM has a single non-company factor and a single beta, whereas APT separates out non-company factors into as many as proves necessary. Each of these requires a separate beta. The beta of each factor is the sensitivity of the price of the security to that factor.

APT does not rely on measuring the performance of the market. Instead, APT directly relates the price of the security to the fundamental factors driving it. The problem with this is that the theory in itself provides no indication of what these factors are, so they need to be empirically determined. Obvious factors include economic growth and interest rates. For companies in some sectors, other factors are obviously relevant as well – such as consumer spending for retailers.

The potentially large number of factors means more betas to be calculated. There is also no guarantee that all the relevant factors have been identified. This added complexity is the reason APT is far less widely used than CAPM. Further, the APT is based on the following assumptions:

- There exist some important systematic risks driving security returns in a linear fashion
- Investors *perceive* these risks and can estimate the sensitivity of the security to them
- Some investors are risk takers in the economy
- These investors can and will exploit differences in expected return by undertaking risk arbitrage

Unlike the CAPM, the APT visualizes a world with many possible sources of risk and uncertainty. More formally, it is based on the assumption that there are a few major macroeconomic factors that influence security returns. No matter how thoroughly you diversify, you cannot avoid these factors, although you can tilt your portfolio away from them. The APT claims that investors will "price" these factors precisely because they are sources of risk that cannot be diversified away. That is, they will demand compensation in terms of expected return for holding securities exposed to these risks. Just like the CAPM, this exposure is measured by a factor beta.

Although the number of potential factors is unlimited, we may not actually need to identify the economy's risk factors. We only need to find a collection of things that together are good proxies for them. An important research by Chen, Roll and Ross found that a collection of four or five macroeconomic series explain security returns fairly well. These factors turned out to be surprises in inflation, Surprises in GNP, surprises in investor confidence (measured by the corporate bond premium) and shifts in the yield curve.

The APT is a useful tool for building portfolios adapted to particular needs. For example, suppose an oil company wanted to create a pension fund portfolio that was insulated against shock to oil prices. The APT allows the manager select a diversified portfolio of stocks that has low exposure to inflation shocks (oil prices are correlated to inflation). If the CAPM is a "one size fits all" model of investing, the APT is a "tailor-made suit". In the APT world, people can and do have different tastes and care more or less about specific factors.

4.19 Concluding Comments

Creating optimal (i.e., mean-variance efficient) portfolios of risky assets depends not just on the risk-return characteristics of each security – it also depends on the risk-return relationships *between* every security in the portfolio. While portfolio return can be expressed as a simple weighted average of the returns for each risky asset, portfolio risk depends on the variance of returns of each asset *and* the covariance of returns between each asset.

A crucial insight of MPT is that even very risky assets can reduce a portfolio's overall risk if there is a low covariance of returns between this risky asset and the other assets in the portfolio.

One significant consequence of this insight is that the only meaningful aspect of risk to consider for any individual risky asset is its contribution to the overall risk of a portfolio (i.e., increasing or decreasing the average risk of the portfolio). Why hold the risky asset on its own – with exposure to its total risk– if you could combine it in a well-diversified portfolio with other risky assets that reduced your risk exposure to that asset?

Rational investors will select their optimal portfolio along this efficient frontier depending on their personal risk tolerances and preferences. Some will opt for the best return they can get for a maximum risk level they will tolerate. Others will target a desired return and attempt to minimize the level of risk in the best portfolio this return target.

4.20 End of the Chapter Exercises

1. Refer to the data given below

	Stock 1	Stock 2
Mean weekly returns	0.52	0.08
Standard deviation	6.98	3.78

Correlation coefficient = 0.31
Covariance = 8.30

Calculate portfolio return and standard deviation for various compositions and plot a graph. Identify the minimum risk portfolio.

2. Calculate the expected return for a stock whose beta is 0.8. The T-bond rate is 6%. The monthly return on the market index is 1.7%.
3. You are holding three stocks. Their individual betas are 0.8, 0.96 and 0.81, respectively. Assuming equal investment calculate the portfolio beta.
4. What factors do you think will affect the beta of a stock? Why do different stocks have different betas?
5. Given below is the correlation matrix for three stocks.

	A	B	C
A	1.0	0.37	0.49
B	0.37	1.0	0.66
C	0.49	0.66	1.0

Other information:

E (*R*)	0.04	0.10	0.09
Variance	0.02	0.03	0.008
Standard deviation	0.14	0.17	0.089

Calculate expected portfolio return and variance for various compositions.

6. Given below are stock and market returns. Calculate mean and standard deviation of returns, correlation and covariance.

Year	Stock return (%)	Market return (%)
1987	7.64	14.31
1988	16.98	−8.50
1989	−11.36	4.01
1990	21.12	18.98
1991	−30.01	−26.48
1992	−22.14	−14.66
1993	37.68	37.20
1994	28.27	23.84

7. The following data are available for three stocks

Stock	Variance	Cov (*i*,*m*)	Corr. (*I*,*m*)
1	114.4	52.58	0.84
2	72.50	42.50	0.85
3	283.73	28.0	0.30

Market variance = 34.30

Which of the stocks is the riskiest? Rank them.

Appendix 1: Portfolio Optimization Inputs

Modify Correlation Matrix Manually

Data is entered as: Prices / Returns

Maintain Return Level

Target Return

Risk free Rate:	0.36%						2.00%
Min Constraint:	10.00%	30.00%	0.00%	0.00%	10.00%	0.00%	0.00%
Max Constraint:	70.00%	90.00%	100.00%	80.00%	100.00%	100.00%	100.00%
Current Units:	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Product Name:	MSFT	IBM	INTC	SUNW	AMZN		
Jan-03	47	78	16	3	22		
Feb-03	24	78	17	3	22		
Mar-03	24	78	16	3	26		
Apr-03	26	85	18	3	29		
May-03	25	88	21	4	36		
Jun-03	26	83	21	5	36		
Jul-03	26	81	25	4	42		
Aug-03	27	82	29	4	46		
Sep-03	28	88	28	3	48		
Oct-03	26	89	33	4	54		
Nov-03	26	91	34	4	54		
Dec-03	27	93	32	4	53		
Jan-04	28	99	31	5	50		
Feb-04	27	97	29	5	43		
Mar-04	25	92	27	4	43		
Apr-04	26	88	26	4	44		
May-04	26	89	29	4	49		
Jun-04	29	88	28	4	54		
Jul-04	28	87	24	4	39		
Aug-04	27	85	21	4	38		
Sep-04	28	86	20	4	41		
Oct-04	28	90	22	5	34		
Nov-04	27	94	22	6	40		
Dec-04	27	99	23	5	44		

Historic Observation Periods

Source: Business Spreadsheets

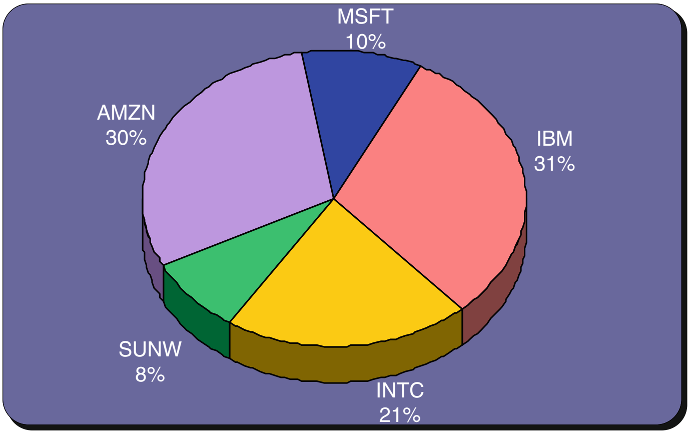
Appendix 2: Covariance/Correlation Matrix

CORRELATION MATRIX					
Risk free Rate:	0.36%		No. Products:	Mean	0.48%
Iterations:	2500		5	StdDev	6.03%

Product	Weight	Min	Max	Mean	StdDev	MSFT	IBM	INTC	SUNW	AMZN
MSFT	14.16%	10.00%	70.00%	-1.06%	9.55%	100.00%	9.44%	-10.14%	-22.16%	11.75%
IBM	44.52%	30.00%	90.00%	0.28%	5.35%		100.00%	29.36%	30.79%	44.88%
INTC	13.52%	0.00%	100.00%	1.72%	8.97%			100.00%	27.25%	45.12%
SUNW	2.27%	0.00%	80.00%	1.52%	11.61%				100.00%	22.05%
AMZN	25.53%	10.00%	100.00%	3.05%	13.12%					100.00%

Source: Business Spreadsheets

Appendix 3: Optimization Results



Mean	Std Dev	Sharpe Ratio
1.37%	6.36%	**0.159**
	Probability of achieving 2.0% target return :	**46.05%**

Optimal Weighting	Units
10.33%	0.73
30.77%	0.69
20.71%	1.53
8.36%	3.69
29.83%	1.17
100.00%	

Source: Business Spreadsheets

References

Altman E (1968) Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. J Finance 23

Berry MA, Burmeister E, McElroy MB (1988) Sorting out risks using APT Factors. Financ Anal J

Black F, Jensen MC, Scholes M (1972) The capital asset pricing model: some empirical tests. In: Jensen MC, (ed.) Studies in the theory of capital markets. Praeger, New York

Bollerslev T (1986) Generalized autoregressive conditional heteroskedasticity. Journal of Econometrics, 31(3), 307–327

Bower D, Bower R, Logue D (1984) Equity screening rates using arbitrage pricing theory. In: Lee CF (ed.) Advances in financial planning. JAI Press, Greenwich, CT

Bower D, Bower R, Logue D (1984) Arbitrage pricing theory and utility stock returns. J Finance XXXIX(4)
Bower D, Bower R, Logue D (1992) A primer on arbitrage pricing theory. In: Stern J, Chew D (eds.) The revolution in corporate finance. Basil Blackwell, Oxford, UK
Bower D, Bower R, Logue D (1995) Size and book-to-market factors in earnings and returns. J Finance L(1)
Chan LKC, Lakonishok J (1993) Are the reports of beta's death premature? J Portfolio Manage 19
Cochrane J (1999) New facts in finance. NBER Working Paper No 7169
Dimson E, Marsh P, Staunton M (2002) Triumph of the optimists: 101 years of global investment returns. Princeton University Press
Divecha AB, Drach J, Stefek D (1992) Emerging markets: a quantitative perspective. J Portfolio Manage
Elton EJ, Gruber MJ Modern portfolio theory and investment analysis. Wiley, 5th ed.
Engle RF (1982) Autoregressive Conditional Heteroscedasticity with Estimates of the Variance of United Kingdom Inflation. Econometrica, 50(4), 987–1007
Erb CB, Harvey C, Viskanta T (1996) Expected returns and volatility in 135 countries. J Portfolio Manage
Fama E, MacBeth JD (1973) Risk, return and equilibrium: empirical tests. J Politic Econ 81
Fama E, French K (1992) The cross section of expected stock returns. J Finance
Fama E, French K (2001) Disappearing dividends: changing firm characteristics or lower propensity to pay. J Financ Econ 60(1)
Gebhardt W, Hvidkjaer S, Swaminathan B (2001) The cross section of expected bond returns: betas or characteristics? Unpublished Working Paper, Johnson Graduate School of Management, Cornell University
Hughson E, Stutzer M, Yung C (2006) The misuse of expected returns. Financ Anal J
Jones C, Wilson J, Lundstrum L (2002) Estimating stock returns. J Portfolio Manage
Kothari SP, Shanken J, Sloan R (1995) Another look at the cross section of expected stock returns. J Finance L(1)
Kupiec P (undated) Stock market volatility in OECD countries: recent trends, consequences for the real economy, and proposals for reform. Working Paper No 94, Department of Economics and Statistics, Board of Governors of the Federal reserve System, Washington DC
Modigliani F, Pogue G (1979) An introduction to risk and return: concepts and evidence. Financ Anal J
Mullins D Jr (1982) Does the capital asset pricing model work? Harvard Business Review
Odier P, Solnik B (1993) Lessons for international asset allocation. Financ Anal J
Reinganum MR (1981) The arbitrage pricing theory: some empirical results. J Finance XXXIV(2)
Roll R, Ross S (1980) An empirical investigation of the arbitrage pricing theory. J Finance
Roll R, Ross S (1983) Regulation, the capital asset pricing model and the arbitrage pricing theory. Public Utilities Fortnightly
Roll R, Ross SA (1985) The arbitrage pricing theory approach to strategic portfolio planning. Financ Anal J
Rosenberg B, Rudd A (1992) The corporate uses of beta. In Stern J, Chew D (eds.) The revolution in corporate finance. Basil Blackwell
Ross SA (1976) The arbitrage theory of capital asset pricing. J Econ Theor 13
Sharpe WF (1964) Capital asset prices: a theory of market equilibrium under conditions of risk. J Finance XIX(3)
Siegel J (1999) The shrinking equity premium. J Portfolio Manage
Siegel J, Thaler R (1997) The equity premium puzzle. J Econ Perspectives 11(1)
Solnick B (1974) Why not diversify internationally rather than domestically? Financ Anal J
Statman M (1987) How many stocks make a diversified portfolio? J Financ Quant Anal 22(3)
Wagner WH, Lau S (1971) The effect of diversification on risk. Financ Anal J 26

Chapter 5
The Capital Asset Pricing Model and Arbitrage Pricing Theory: Tests and Application

S.R. Vishwanath

5.1 Chapter Introduction and Objectives

This chapter builds on the material covered in the last chapter. In this chapter, we describe the following:

- Issues in measuring capital asset pricing model (CAPM) parameters
- Other approaches for measuring expected stock returns
- Criticisms of CAPM
- The Fama–French (FF) three-factor model
- Issues in implementing advanced portfolio technologies (APT)
- The difficulty in applying CAPM in emerging markets

The last chapter provided a framework for pricing risky assets. In a CAPM universe, only systematic risk as measured by the beta matters. This chapter describes the application of CAPM in estimating required returns. The expected return for the equity investor in a CAPM universe,

$$\mathrm{E}(R) = R_\mathrm{f} + \beta[\mathrm{E}(R_\mathrm{M}) - R_\mathrm{f}].$$

The CAPM is commonly used by analysts and fund managers for the purpose of valuation, stock selection, and performance measurement.

It is important to understand that cost of equity is not the same thing as dividends. The cost of equity incorporates both dividends and capital gains expected by investors. Estimation of cost of equity using CAPM involves estimation of risk-free rate, beta, and market risk premium.

S.R. Vishwanath
Institute of Management Technology, 603, Khullar Apartments, Byramji Town,
Nagpur 440001, India
e-mail: srvishy@gamil.com

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_5,

5.2 Estimation of Risk Free Rate

The investor's expected rate of return consists of two components: the time value of money and risk premium. A risk free asset rewards the investor for time value of money alone. Further, a risk-free asset is one whose returns are certain (i.e., variance is zero) and unconnected with that of the market (i.e., covariance is zero). Generally, finance theorists agree that long T-Bond rate can be used as proxy for risk free rate. Sometimes the 365-day T-Bill rate is also used. Obviously, what you choose as R_f has a bearing on the cost of equity estimate as it appears twice in the equation. As the T-Bill rate tends to be volatile, the long-term T-Bond rate might be chosen. The T-Bill rate is proposed when the investor has a short-term investment horizon. From a finance manager's perspective, the T-Bond rate might be the appropriate rate. It must be understood that there is no such thing as risk free asset. The government securities do not have default risk[1] but reinvestment risk remains.

Academic studies in US have shown that the long-term bonds are not completely riskless. The government bond returns are positively correlated with stock market returns. That is, government bonds have systematic risk (beta). To arrive at riskless rate, the systematic component of bond yield should be deducted from the prevailing bond yield. To illustrate, suppose risk premium = 6.7%, beta of T bonds = 0.25, and current bond yield = 5.5%.

$$\text{True risk free rate} = \text{current bond rate} - \text{systematic component},$$
$$= 5.5 - (0.25^{*}6.7) = 3.81\%.$$

5.3 Estimation of Beta

In the capital asset pricing model, beta is the sole company specific factor. The estimates of risk free rate and market premium are same for all stocks. Beta is the only link between investor's expected return from the stock with the expectations of market returns. So, the estimate of beta should be accurate. Often, academics and practitioners estimate the historical beta and use it as proxy for future. The CAPM is supposed to be a forward looking model. So, what we really need is ex-ante (expected) beta. The standard practice is to regress stock returns against returns from a stock market index representing the market portfolio to estimate the beta of a stock.

Regression analysis is used to establish relationship between two or more variables. The dependent variable is the one we are trying to predict and the other is the independent variable. Regression analysis can use two variables (called simple regression) or can include many independent variables. By measuring exactly how large and significant each dependent variable has been historically in relation to the

[1] This is not true of those countries, which default on sovereign borrowings. In such a situation, we can probably take a rate which is slightly lower than the rate on AAA rated debt instruments as risk free rate (say 50 basis points).

dependent variable, the future value of the dependent variable value can be predicted, which is the goal of inferential statistical analysis. Essentially, regression analysis attempts to measure the degree of correlation between the two variables, thereby establishing the predictive value of the dependent variable. Using a scatter diagram one could plot the values of the dependent variable over a, say, 10-year period in relation to the values of the independent variable. A line connecting the average dots, called a trend line, would reveal the degree of correlation between the two factors by showing the amount of unexplained variation (represented by the dots that fall outside the line). Thus, if the line connected all the points, it would show a direct relationship between the two variables. On the contrary, the number of dots scattered outside the trend line would indicate no relationship, with a high enough degree of variation determining that no relationship exists between the variables.

This proportion of unexplained variation is termed as the coefficient of determination (represented by the symbol R^2). The square root of this number is the correlation coefficient. A correlation of 1 is equal to a direct positive relationship; a correlation of 0 simply means that there is no relationship between the two variables; and a correlation of -1 implies that the relationship is negative.

The plot of security returns (in per cent) vs market returns (in per cent) is called a security characteristic line. A typical characteristic line is shown in Exhibit 5.1.

Each dot corresponds to return from the stock and the market return in that period. A line can be fitted to the array of points to explain the relationship. The line of best fit minimizes the distance from the dot and the line.

The regression equation we obtain is of the form

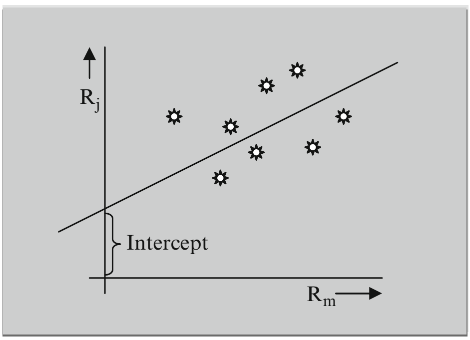
$$R_{\mathrm{j}} = a + bR_{\mathrm{m}},$$

where a is the intercept, b is the beta of the stock, R_{j} is the return on the stock, R_{m} is the return on the market index.

To estimate beta, calculate the holding period return for both the stock and the market for some interval of time.

$$\text{Holding period return for the stock} = \frac{(P_t - P_t{-}1) + Div}{P_{t-1}},$$

Exhibit 5.1 Security characteristic line



where P_t and P_{t-1} are current and prior prices, *Div* is the dividend received. Similarly,

$$\text{Index return} = \frac{[\text{Value of Index at the end-value at the beginning}]}{\text{Beginning value on index}} + Div.\ Yield.$$

Microsoft Excel has a tool that allows us to graphically represent two variables. The tool is the chart wizard, and the output is a scatter diagram. Excel also allows us to perform a regression analysis. To analyze a data table using the regression tool follow these steps:

Step 1: Click on Tools from Menu Bar and select Data Analysis
Step 2: Select regression and click OK
Step 3: With your cursor in the Input Y Range cell, use your mouse to highlight the data in the stock return column; do not select the label
Step 4: With your cursor in the Input X Range cell, use your mouse to highlight the data in the market return column; do not select the label
Step 5: Under output options, place your cursor in the Output Range cell and use your mouse to select labelled output cell; click Ok

The intercept is the y-intercept value (a-value) and the size coefficient is the slope (b-value) in the linear equation. Exhibit 5.2 presents the beta estimates for some US companies.

Estimation period (i.e., the period over which the beta is estimated): The model doesn't specify the time period over which betas have to be estimated. An analyst has the liberty to choose an appropriate time period. Typically, analysts use 2 year and 5 year data. The latter is more popular. The longer the period, the more the number of observations and more meaningful is the estimate. But macroeconomic changes may be better reflected in recent data. Further, the company itself might have changed in risk complexion. So there is a trade off between number of data points and accuracy. Given below is the estimate of beta for Disney for various lengths of time.

Time period used (years)	Beta estimate
3	1.04
5	1.13
7	1.09

Source: Aswath Damodaran, Stern School of Business, New York University

Estimation interval (i.e., the starting and ending points of the estimation interval): One could randomly choose a starting and ending point or choose some deliberate interval. Some start with January, some with July. There are no rules except that an analyst should avoid data that are abnormal. For instance, for some reason if the returns in January are consistently more than returns in other months, one could avoid January data.

Exhibit 5.2 Beta estimates for some US companies

Regression statistics	S&P	3M	AT&T	Boeing	Citigroup	Disney
Calculated beta	1.00	0.664	0.94	0.974	1.334	1.168
Adjusted beta	1.00	0.776	0.96	0.983	1.223	1.112
R^2	1.00	0.199	0.215	0.215	0.637	0.397
Standard error of estimate	0.00	0.057	0.077	0.08	0.043	0.062

Market proxy: A stock market index is generally used as a proxy for the market portfolio that is supposed to cover all risky assets in the economy. The beta estimate is sensitive to the market proxy used. We could use the S&P 500 index or Dow Jones or any other market proxy. As long as these indices are highly correlated, it doesn't really matter which index is chosen. But the problem is that none of these indices might be good proxies for the market portfolio.

The differences in beta estimates are not dramatic although different proxies do give different results.

Given below is the beta estimate for Disney using monthly data from 1 January 1993–1997 for various market proxies.

Index used	Beta calculated
Dow 30	0.99
S&P 500	1.13
NYSE composite	1.14
MS capital index	1.06

Source: Aswath Damodaran, Stern School of Business, New York University

Choice of return interval: The analyst can choose weekly, monthly, quarterly or annual data to estimate beta. The normal practice is to use weekly returns. The choice is made depending on whether weekly or monthly returns have significant correlation with beta. CAPM can be applied only if there is correlation between holding period returns and beta.

Given below is the beta estimate for Disney using different return intervals.

Return interval used	Beta estimated
Daily	1.33
Weekly	1.38
Monthly	1.13
Quarterly	0.44
Annual	0.77

Source: Aswath Damodaran, Stern School of Business, New York University

In general, the betas of securities with a smaller market value than the average of all securities outstanding (the market) decrease as the return interval is shortened whereas the betas of securities with a large market value relative to the market increase (Hawawini 1983). This suggests that betas measured over arbitrary lengths will be biased.

The beta estimates come with statistical "noise." The quality of regression can be determined by some simple statistical parameters like standard error and R^2. A confidence interval gives an estimated range of values which is likely to include an unknown population parameter, the estimated range being calculated from a given set of sample data. If independent samples are taken repeatedly from the same population, and a confidence interval calculated for each sample, then a certain percentage (confidence level) of the intervals will include the unknown population parameter. Confidence intervals are usually calculated so that this percentage is 95%, but we can produce 90%, 99%, and 99.9%, confidence intervals for the unknown parameter. A confidence interval for a mean specifies a range of values within which the unknown population parameter, in this case the mean, may lie. We interpret an interval calculated at a 95% level as we are 95% confident that the interval contains the true population mean. We could also say that 95% of all confidence intervals formed in this manner (from different samples of the population) will include the true population mean.

If the beta estimate is 0.8 and the standard error of beta is 0.30, we could be 99% confident that the true beta lies in the range of -0.10 and 1.7 (i.e. $\pm 3\sigma$ limit). R^2 provides an estimate of the proportion of risk (variance) of the stock that can be traced to the systematic factors. The balance $(1 - R^2)$ is the unsystematic risk.

5.3.1 An Illustration

Reliance Industries is a large business conglomerate in Asia. The weekly returns of Reliance were regressed against the Bombay Stock Exchange Sensitive Index returns for the period 1994–1997. The results of the regression are the following:

$\alpha = 0.3197$
$\beta = 1.54$
Standard error of beta $= 0.177$
2σ limit $= 1.54 \pm (2 \times 0.177)$

So, we can be 95% confident that the true beta lies in the range 1.186–1.894. The R^2 of the regression is 0.44. That is, 44% of total risk is systematic and the rest unsystematic.

The beta of 1.54 suggests that RIL stock is riskier than average stock. This estimate may be compared with publicly available estimates such as the ones provided by newspapers. They may not match due to estimation issues outlined earlier.

The holding period return is the sum of capital gains yield and dividend yield. Dividends are paid semi annually or annually. For calculating returns, dividends are added to the capital gain/loss in the month in which the stock goes ex-dividend. That is dividends are not added in all the months but only in that month in which dividends are announced.

5.4 Adjusted Beta

Two common adjustments that are made to betas calculated using the Ordinary Least Squares (OLS) regression technique

1. *Mean Reversion:* This adjustment is based on the observation that historically observed betas are not stable over time and tend to regress towards a value of one (the Market Portfolio beta). One common formula used (called the Blume adjustment) is

$$\beta(\text{adjusted}) = (2/3)\beta(\text{calculated}) + (1/3)\beta(\text{market}),$$

   where $\beta(\text{market})$ by definition equals one. Another approach based on Bayesian statistics is called the Vasicek adjustment.
2. *Thin Trading*: This adjustment is for stocks that do not trade regularly and reflects the observation that thin trading creates a downward bias in the estimated betas for these types of companies. One approach used here is called the Dimson adjustment. Another technique is called the Scholes–Williams adjustment.

The advantage of calculating your own beta estimates is that you get to create your own "recipe" (Return Interval: daily/weekly/monthly; Estimation Period: 1–5 years is most common; choice of a Market Portfolio Proxy; and any "special ingredients"/adjustments). And most spreadsheet programs provide a linear regression function that calculates not only a beta (the slope of the company's returns regressed against the returns of the Market Portfolio proxy) but other important statistics like the y-intercept, R^2 and Standard Error of the Estimate (to establish confidence intervals around your estimate of beta). Beyond the freedom that estimating your own betas provides, there are other reasons why the "Do-It-Yourself" approach may be necessary:

1. No commercial beta estimation service covers the company you are interested in.
2. It is a private company.
3. The company has recently undergone major changes in its business circumstances, strategy, or model (rendering historically-based beta estimates unreliable).

5.5 Estimation of Market Return and Market Premium

Market return is the average of past realized return on market index. Weekly or monthly intervals are chosen and the average return is calculated for the period. The average could be arithmetic mean or geometric mean. Some theorists argue that arithmetic mean is consistent with the mean–variance framework of CAPM. There are some pitfalls in using arithmetic mean. Suppose the price of an asset increases from \$100 to \$200 and then falls to \$100. HPRs are 100% and −50%. The arithmetic mean is 25%. Clearly, the return is zero.

$$\text{The geometric mean} = [(1+1)(1-0.5)-1]^{1/2},$$
$$= 0.$$

So, some argue that the geometric mean of returns should be used. Exhibit 5.4 shows the arithmetic and geometric mean returns in stock markets around the world. The actual returns earned by stocks (i.e. index) over a long period of time over and above the actual return earned on a default free security is the market premium, $R_{\mathrm{m}} - R_{\mathrm{f}}$. The arithmetic average of returns on government bonds is deducted from the average returns from stocks. This historical premium is used as proxy for future risk premium. The choice of index, obviously, affects the market premium estimate. The premium in case of USA and UK are 5.5% and 8–9%, respectively. The returns and risk premia for many countries and the USA are presented in Exhibits 5.3– 5.5.

Risk premium as measured by the historical difference between stocks and bonds usually suffers from statistical noise. Further, risk premiums may change over time.

Exhibit 5.3 Returns around the world

			Monthly			
Country	Source	Sample start	Mkt cap m \$	A.M returns %	G.M returns %	Std dev %
Argentina	IFC	Oct 1979	17,939	42.0	7.9	93.1
Brazil	IFC	–	81,800	33.1	14.0	64.0
India	IFC	–	71,904	17.4	14.1	29.5
Indonesia	IFC	Oct 1990	21,841	3.3	−1.4	30.8
Mexico	IFC	Oct 1979	47,962	20.8	9.1	46.5
Taiwan	IFC	Oct 1985	147,472	35.8	25.9	51.3
Thailand	IFC	Oct 1979	90,882	22.1	20.1	27.1
Venezuela	IFC	Oct 1985	2,992	21.7	11.5	46.1

Source: Erb, Harvey, and Viskanta (1996)

Exhibit 5.4 Risk premium for select Asian countries

Country	Index	MRP %	R_{f} %	Historical premium %	Measurement period
Singapore	STI	6	4	8	87–95
Taiwan	TWSE	6.5	7	10	86–96
Korea	KOSPI	6.5	10	6	85–96
Malaysia	KLSE	8	7	8.5	85–96
Hong Kong	HIS	7.5	8	8.8	69–96
Thailand	SET	9	13.5	14	86–96
India	BSE 100	8	13	10.5	91–96

Source: C S First Boston

Exhibit 5.5 Equity premiums (%) – US Data, 1802–1998

	Equity premium with bonds		Equity premium with bills	
	Geometric	Arithmetic	Geometric	Arithmetic
1802	3.5	4.7	5.1	5.5
1802	2.2	3.2	1.9	2.9
1871	2.9	4.0	3.4	4.6
1926	5.2	6.7	6.7	8.6
1946	6.5	7.3	7.2	8.6

Market risk premium 1985–2006	Geometric mean returns (%)	Arithmetic mean returns (%)
Market return	13.13	14.39
T Bond Return	9.12	9.57
Market risk premium	4.01	4.82

Source: Jeremy Siegel (1999)

So adding a constant risk premium to the T-bond rate might be inappropriate. The CAPM parameters can be estimated individually, as demonstrated in the preceding sections, and then plugged into CAPM to arrive at the expected return.

5.5.1 An Illustration

The expected return for Reliance Industries is estimated below:

Risk free rate	12.15%
Market premium, $R_m - R_f$	10%
β	1.54
Expected return	$12.15 + 1.54(10) = 27.55\%$

If we were to use the short term T-Bill rate,

$$\begin{aligned}\text{Expected return} &= 8\% + 1.54(10\%)\\ &= 23.4\%\end{aligned}$$

The difference is about 4%. There is no total consensus on how the CAPM parameters are to be estimated.

5.6 Other Approaches for Estimating Expected Return

There are two other popular methods for calculating cost of equity: risk premium approach and DCF approach

5.6.1 *The DCF Approach*

The price of a stock, P_0, on the day the most recent dividend, D_0, is paid is the present value of future dividend stream.

$$P_0 = D_0 \sum_{t=1}^{\infty} (1+g)^t/(1+r)^t,$$

where $g =$ per period growth in dividends
$r =$ investor's expected rate of return

The rate of return that equates the current market price and future dividend payments is the expected equity return.

The model is based on some assumptions:

- The future rate of growth, g, is constant
- The rate at which the investor discounts future cash flows, r, is constant
- Dividends are paid annually
- The expected return is calculated on the day the most recent dividend is paid.

If we assume that the dividends grow at constant rate forever,[2]

$$P_0 = [D_1/k - g],$$
$$K = [D_1/P_0] + g.$$

Cost of equity = next period dividend yield + growth in dividends.

The normal practice is to use a two-stage dividend growth model as shown below.

The expected future dividend stream can be split into two periods: non-constant growth period (say 4 years) and constant growth period thereafter.

$$P_0 = \frac{D_1}{(1+\mathrm{k})} + \ldots\ldots\ldots + \frac{D_4}{(1+\mathrm{k})^4} + \frac{D_4(1+g)}{(\mathrm{k}-g)}[1/(1+\mathrm{k})^n.$$

With a forecast of D_1, D_2, D_3, D_4, and g, the cost of equity can be found by trial and error. Elsewhere in the world, analyst forecasts of dividend and constant growth rate is used to estimate expected equity return.

The constant growth rate in dividends can be calculated by multiplying the expected retention ratio in year 4 with return on equity.

$$g = (\text{Retention ratio in year4})^* (\text{ROE}).$$

The Gordon model could also be used for estimating risk premium.

$$P = [D_1/(\mathrm{k}-g)].$$

[2] This is the famous Gordon Model.

Extending the concept to the market as a whole

$$\text{Market Value} = \frac{\text{Expected dividends next year}}{\text{Required return on stocks} - \text{Expected growth rate}}.$$

Given the current market value, expected dividends and growth rate in earnings and dividends in the long run, one can solve for required return on equity. Subtracting the risk free rate from this yields the risk premium.

To illustrate, if,

$$\text{Index value} = 3500, \text{dividend yield on the index} = 8\%, \text{expected growth rate} = 7\%$$
$$3500 = [(0.08 \times 3500)/(r - 0.07)],$$
$$\text{Required return on equity} = 15\%.$$

If risk free rate is 12%, the premium is 3%.

5.6.2 *Risk Premium Approach*

Under the risk premium approach, a risk premium is added to the yield (YTM) on the company's bonds (to reflect the higher risk borne by shareholders) to estimate cost of equity.

$$\text{That is, cost of equity} = \text{Bond yield} + \text{risk premium.}$$

The equity risk premium can be calculated in two ways – historic yield spread method and ex-ante yield spread based on DCF analysis.

The historic risk premium is the difference between the average of annual returns on a stock index in the past (say 10 years) and the average of annual returns on a bond index over the same period.

Historic yield spread = Average return on stock index − Average return on bond index.

The normal practice is to use geometric return on the indices. The historic premium is then added to company's bond yield to obtain an estimate of cost of equity. The shortcoming of this method is that the estimate is affected by the period chosen and end points of the period.

Under the ex-ante (expected) risk premium method, the average expected future return on a group of stocks, say index stocks, is calculated and the concurrent risk free rate is subtracted from it. The yield on long term T-Bond could be taken as R_f.

$$RP_M = R_M - R_f.$$

The DCF model may be used to estimate expected return on stocks. A survey of analysts' forecast of growth rate in dividends may be used as surrogate for 'g' in the equation.

$$K_e = (D_1/P_0 + g).$$

The simple logic underlying risk premium approach is that if the premium is expected to remain constant overtime, then the constant premium may be added to the prevailing interest rate to obtain cost of equity. The risk premium should be estimated for fairly long periods of time. Academic studies make use of data for few decades.

5.7 Industry Beta

The beta of any individual asset is

$$\beta_i \frac{\mathrm{Cov}(R_\mathrm{i} - R_\mathrm{m})}{\mathrm{Var}(R_\mathrm{m})}.$$

Now consider a portfolio with weights W_p. The beta of the portfolio is

$$\beta_\mathrm{p} = \frac{\mathrm{Cov}(R_\mathrm{p} - R_\mathrm{m})}{\mathrm{Var}(R_\mathrm{m})},$$

$$= \sum_{\mathrm{i}=1}^{n} W_\mathrm{i}\beta_\mathrm{i}.$$

The betas of individual stocks tend to be fickle. They change quite rapidly. Portfolio betas, on the other hand, are more stable. Their standard errors are generally lower than that of individual betas. The weighted average of betas of stocks in the same industry group, say Pharma, is called industry beta, the weights are market capitalization (number of shares outstanding multiplied by market price) of individual companies. What purpose does industry beta serve? Let's suppose a company is in the process of appraising a banking project. So its executives are interested in estimating cost of equity for the project. They can use the parent company's beta or the banking industry beta. Common sense tells us that the banking industry beta is more indicative of what investors expect from *that* project. In other words, expected return is project specific. Exhibit 5.6 presents the cost of capital for several industry groups in the USA.

5.8 Fundamental Beta

Since firm characteristics change over a period of time we would expect beta to change. So putting too much emphasis on history might be unwise. Consequently, some academicians like Beaver, Ketler and Scholes (1970) and Rosenberg and Marathe (1975) have attempted to establish relationship between systematic risk and its determinants like payout ratio, growth, leverage, liquidity ratio, size of the firm,

Exhibit 5.6 Industry cost of capital for US industries

Industry	Industry lev. Beta	Cost of equity	Cost of debt	Debt/capital %	Cost of capital %
Aerospace	0.68	8.6	9.1	38.6	7.3
Airlines	0.89	10.8	9.8	70.4	7.4
Beverages	0.89	10	8.1	45.7	9.3
Cars and trucks	1.03	12.4	8.5	46.6	8.7
Computers and peripherals	1.36	12.9	8.6	30.7	12.7
Electronics	1.51	14.1	10.6	39.1	13.5
Oil and Gas (integrated)	0.60	7.9	8.6	46.7	6.9
Restaurants	0.80	9.5	10	46.4	8.6

Source: Petit, Justin, Ivan Gulic, and April Park, "The Equity Risk Measurement Handbook", EVAluation, Stern Stewart & Co, Vol 3, March 2001

EPS variability. Studies have shown that the beta obtained from such "fundamental factors" is more stable. About 54 factors in six categories are supposed to influence beta. A growth-oriented strategy implies large capital investment plans. Such long-term investments typically translate into higher uncertainty about the eventual outcome and hence risk. So we would expect growth to be a consistent predictor of beta. Likewise, earnings variability is another important predictor of beta. An important research by Robert Hamada shows that the beta of a stock depends on operating and financial leverage of a firm. An increase in either of them or both will lead to an increase in beta, and hence the cost of equity.

The relationship between levered and unlevered beta is given here.

We know that

$$V = D + E.$$

That is, the value of the firm equals the sum of values of debt and equity.

Multiplying both sides by their respective beta,

$$\beta_{\mathrm{A}} V = \beta_{\mathrm{D}} D + \beta_{\mathrm{E}} E.$$

Dividing both sides by V

$$\beta_{\mathrm{A}} = \beta_{\mathrm{D}} D/V + \beta_{\mathrm{E}} E/V.$$

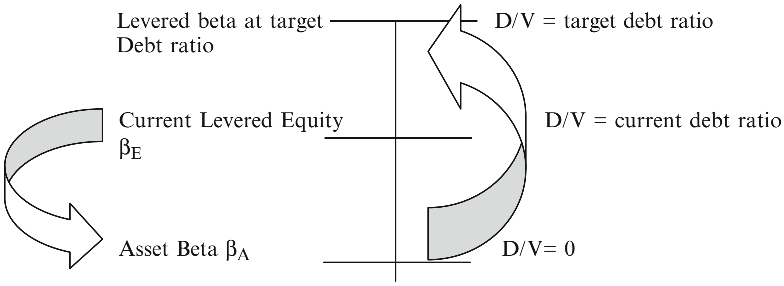
That is, asset beta is the weighted average of debt and equity beta.

If the beta of debt is assumed to be zero (a somewhat restrictive assumption),

$$\beta_{\mathrm{A}} = \beta_{\mathrm{E}} E/V,$$

or $\beta_{\mathrm{E}} = \beta_{\mathrm{A}}(V/E)$

Exhibit 5.7 The relationship between asset beta and equity beta



The beta that we estimate by regressing stock returns against market returns should not be directly plugged into CAPM. It should be relevered using the above relationship at the target debt ratio and then plugged. Assume that a company currently has a D/V ratio of 0.3. So E/V is 0.6. The target D/V is 0.5. Let the current equity beta be 0.50,

$$\beta_A = \beta_E E/V.$$

Asset beta $= (0.50)(0.6) = 0.3$

$$\begin{aligned} \beta_E \text{ at the target debt ratio} &= \beta_A(V/E), \\ &= (0.3)(1/0.5), \\ &= 0.6. \end{aligned}$$

As you can see, the estimate is more than the current beta, for obvious reasons.

The relationship between asset beta and equity beta is shown graphically in Exhibit 5.7:

5.9 Estimation of CAPM Parameters for Unlisted Companies and Divisions

The CAPM can be used to estimate the cost of equity for a listed firm. An unlisted division, by definition, does not have stock market data. So CAPM cannot be applied directly. The accepted procedure is to follow the “pure play” technique. Since the beta for the division is unobservable in the market place, a proxy beta derived from a publicly traded firm whose operations are as same as possible to the division in question is used as the measure of the division’s systematic risk. The pure play approach attempts to identify firms with publicly traded securities that are solely engaged in the same line of business as the division. These comparable firms are called pure play firms. A firm should satisfy the following characteristics to qualify as a pure play firm:

- The firm should have only one business line and no miscellaneous revenue.
- The pure play should be in the same industry or business line as the division in question.
- The revenues of the pure play should be roughly the same as those of the division.
- When more than one firm can be identified as a potential pure play, the firm with the median beta could be chosen as pure play.

5.10 Does the CAPM Work?

The CAPM implies that each security's expected return is linear in its beta. A possible strategy for testing the model is to collect securities' beta at a particular point in time and to see if these betas can explain the cross sectional differences in average returns. Consider the following cross sectional regression.

$$R - R_{\mathrm{f}} = \gamma_0 + \gamma_1 \beta + \in .$$

In this regression, R represents the returns of many securities at a particular cross section of time and beta represents the betas of many firms. According to the CAPM, γ_0 should be equal to zero and γ_1 should equal the expected excess return on the market portfolio. The earliest tests of the CAPM were carried out by Black, Jensen and Scholes (1972) and Fama and MacBeth (1973). Both of these tests were cross sectional tests. To test the theory, B-J-S created portfolios on the basis of beta (high to low). A cross sectional regression was run to see if the betas were able to explain the differences in the returns across securities.

$$R - R_{\mathrm{f}} = \gamma_0 + \gamma_1 \beta + \in .$$

The results were

$$\begin{array}{c} R - R_{\mathrm{f}} = 0.0036 + 0.0108\beta \\ \qquad\qquad [6.53] \quad [20.77] \end{array} .$$

The t-statistics are in parenthesis. The CAPM suggests that $\gamma_0 = 0$ and $\gamma_1 > 0$ (and is equal to the expected market return less the risk free rate). The regression evidence does not support this.

5.11 Criticisms of CAPM

The CAPM is based on certain restrictive assumptions such as investors can borrow and lend at risk free rate, etc. Clearly, some of these assumptions are unrealistic. It is not the assumptions that one should question but the predictive ability of the model. In a CAPM universe, high beta portfolios are supposed to yield high returns and low beta portfolios should yield low returns. But empirical evidence does not support this hypothesis, at least for the time period chosen by some researchers. A number of studies have found that betas of stocks do not adequately explain cross sectional differences in stock returns. Instead, other variables with no presence in current asset pricing models seem to have a more significant predictive ability than beta. The most prominent is the size effect noticed by Banz (1981). He finds that market equity adds to the explanation of the cross section of average returns provided by betas. He finds that during the 1936–1975 period, the average returns to stocks of small firms was substantially higher than the average return to stocks of large firms after adjusting for risk using the CAPM. This observation has become known as the *size effect*.

Another contradiction is the positive relation between leverage and average return. Eugene Fama and Kenneth French (1992) argue that a multidimensional model of risk and return is necessary to explain differences in stock returns. Their model incorporates company size (as measured by market capitalization), the ratio of book to market value (BV of equity divided by market capitalization). They show that Banz's finding may be economically so important that it questions the validity of the CAPM in any economically meaningful way.

5.12 The Fama–French Three-Factor Model

The FF 3-factor model is estimated by running a time series multiple regression for each company. The dependent variable is the company's monthly excess stock returns over treasury bill returns. The independent variables are as follows:

- The monthly excess return on the market over treasury bills
- SMB ("small minus big") – the difference between the monthly return on small-cap stocks and large-cap stocks
- HML ("high minus low") – the difference between monthly returns on high book-to-market stocks and low book-to-market stocks

In the FF model, beta measures the sensitivity of a stock to movements in the market.

The *SMB premium* represents the return premium that companies with small market capitalization usually experience relative to companies with large capitalization. It is computed by multiplying the coefficient for the SMB factor in the multiple regression by the difference between the historical average annual returns on the small-cap and large-cap portfolios. This additional return is often referred to as the "size premium."

In practice, the SMB monthly factor is computed as the average return for the smallest 30% of stocks minus the average return of the largest 30% of stocks in that month. A positive SMB in a month indicates that small cap stocks outperformed large cap stocks in that month. A negative SMB indicates the opposite. The historical average from 1926–2002 of the annual SMB premium in the USA has been approximately 3.3%.

The *HML premium* represents the return that investors expect from companies that have a high book equity-to-market equity ratio. The FF model predicts that a company with a high book equity-to-market equity ratio has an excess return that is not captured in the market return. The number presented is the coefficient for the HML factor multiplied by the difference between the historical average annual returns on the high market-to-book and low market-to-book portfolios. This additional return is often referred to as "value premium".

HML is computed as the average return for the 50% of stocks with the highest B/M ratio minus the average return of the 50% of stocks with the lowest B/M ratio each month. A positive HML in a month indicates that value stocks outperformed growth stocks in that month. A negative HML indicates the opposite. Between 1926 and 2002 the size of the value premium in the USA has been 5.1% annually.

The beta provided by the FF model is similar to the beta provided by the CAPM; it is a measure of the risk of a stock relative to the market. By multiplying the FF beta by the equity risk premium, and adding the HML and SMB premiums and the risk-free rate, the expected return for a company is obtained.

For the HML and SMB factors, the regression coefficients have been multiplied by the premium for each of the factors. The data presented is the per cent premium over the market return which each stock receives because of the small company premium and the value premium. An example is in order.

$$\begin{aligned}
&\text{FF Beta} = 0.70, \text{SMB Premium} = 2.53\%, \text{HML Premium} = 4.17\%,\\
&\text{Expected Return} = \text{Risk-Free Rate} + (\text{Equity Risk Premium} \times \text{FF Beta})\\
&\qquad + \text{SMB Premium} + \text{HML Premium}.
\end{aligned}$$

The expected return for the company assuming a risk free rate of 5.9% and a risk premium of 7.8% is

$$5.9\% + (7.8 \times 0.70)\% + 2.53\% + 4.17\% = 18.06\%.$$

Kothari, Shanken and Sloan (1995) argue that Fama and French's findings depend critically on how one interprets their statistical tests. This view, that the data are too noisy to invalidate the CAPM, is supported by Amihud, Christensen and Mendelson (1992) and Black (1993). These studies have questioned the presence of size effect in all the time periods and the statistical methods used to invalidate the CAPM. Amihud et al. find that there is a significant relation between average return and beta is positive and significant.

There are several possible explanations for the inconclusive evidence on the applicability of CAPM:

1. Is the stock market a good proxy for the market portfolio?

   - Only 1/3 non-governmental tangible assets are owned by the corporate sector in the US

- Among the corporate assets, 1/3 are financed by equity
- The index does not consider intangible assets like human capital

2. Measurement error in beta

- We never observe the true beta
- To test the CAPM we use estimates of beta, which are measured with errors
- The measurement error in beta will cause a downward biased estimate for the slope coefficient

3. Measurement error in expected returns

- We use sample means as proxies for the real, unobservable expected returns
- Means are estimated with noise

4. Borrowing restrictions

The CAPM is based on the assumption that there is no restriction on borrowing. Restrictions on borrowing might cause low beta stocks to have higher returns than the CAPM predicts.

Most empirical studies of the CAPM assume that the return on broad stock market indexes is a reasonable proxy for the return on the true market portfolio of all assets in the economy, which is not the case. Consequently, Jagannathan and wang (1993) include human capital as well in their measure of wealth. Since human capital is not observable, they use the growth in labour income as proxy. They show that their version of the CAPM can explain 28% of the cross sectional variation in the average returns in 100 portfolios they constructed (similar to Fama and French).

In an interview with Dow Jones Asset Manager (May–June 1998, pp. 20–28) William Sharpe answered questions relating to the "death of beta" and other competing models. In his words:

> "Is beta dead?" is really focused on whether or not individual stocks have higher expected returns if they have higher betas relative to the market. It would be irresponsible to assume that is not true. That doesn't mean we can confirm the data. We don't see expected returns; we see realized returns. We don't see ex-ante measures of beta; we see realized beta. What makes investments interesting and exciting is that you have lots of noise in the data. So it's hard to definitively answer these questions.

5.13 The Case of Emerging Markets

The risk-return analysis presented so far is appropriate if the portfolio returns can be completely characterized by the mean and standard deviation. A large number of studies have shown that emerging market returns are non-normal and hence cannot be described by mean and variance (Erb et al. 1996). Exhibit 5.8 presents an

Exhibit 5.8 Monthly returns – Mexico

Source: http://www.duke.edu/~charvey/

example of Mexico and Brazil.[3] There are many small returns and a large number of negative returns in case of Mexico. If the Mexican returns were generated from a normal distribution, we would not expect so many negative returns of the magnitude shown in the graph. Thailand is similar to Mexico with some extreme negative observations. The same is true of many other countries. Emerging market returns are not only higher than returns from developed markets but also far more volatile due to economic shocks, military coups and many such factors. In addition, the mean and variance of returns change over time. One recent study of emerging market returns suggests that there is no relation between expected returns and beta measured with respect to the world market portfolio (Harvey 1995). Further, according to CAPM, expected return is a function of beta. The beta is measured by analyzing the way the equity returns covary with a benchmark return. In many countries beta cannot be estimated because the equity market does not exist! One solution to this problem is to establish a relationship between expected returns and, say, country credit ratings.

5.14 Tests and Applications of the APT

The Arbitrage Pricing Theory, like CAPM, aims to analyze the equilibrium relationship between assets' risk and expected return. The key difference between the two models is that the APT explicitly models several factors affecting assets' actual and

[3] These are (were) available at http://www.fuqua.duke.edu/faculty/alpha/charvey.htm

expected returns as opposed to the CAPM's focus on the market portfolio. Further, the APT is based on the concept of arbitrage whereas the CAPM is based on the concept of diversification.

The factor identification process, as must be obvious by now, is highly judgmental. Factors are dropped or introduced as their relevance decreases or increases.

The issue of the identification of risk factors is addressed in three general categories of risk:

- Those pertaining to the firm. Examples include beta vis-à-vis a broad stock market index or a sectoral index or market value of equity, sales, etc.
- Those pertaining to the macroeconomy that are likely to affect the future cash flows of the asset. Examples include a variety of macroeconomic variables like the consumer price index, index of industrial production, consumer confidence, etc.

The third category includes the return on relevant portfolios such as the Fama-French (1992) study.

One of the earliest tests of APT is by Roll and Ross (1980). The result of their test is given below:

No of companies in the sample: 1260 NYSE and AMEX listed companies
Period: 1962–1972
Frequency interval: Daily returns

Shares were grouped into 30 groups in the factor analysis. They found that in over 38% of the groups there was a less than 10% probability that a sixth factor had explanatory power. In over 75% of the groups there was a 50% probability that 5 factors were sufficient. In the second regression at least three factors are significant in explaining the returns. The variance of the residuals from the factor analysis was not statistically significant in the second regression suggesting that only factor risk is relevant for explaining the returns.

In summary, only a few factors were found relevant.

Likewise, in another study, Chen et al. (1986) found that four factors – index of industrial production, differences in promised yields to maturing on AAA versus Baa corporate bonds (default premium), differences in promised yields to maturing on long- and short- term government bonds (term-structure of interest rates) and unanticipated inflation explain the differences in stock returns.

Most academic studies look at five factors in the application of APT to estimate expected returns (Berry et al. 1988):

- Risk of changes in default premiums
- Risk that the term structure of interest rates may change
- Risk of unanticipated inflation or deflation
- Risk that the long-run expected growth rate of profits for the economy will change and
- Residual market risk or any remaining risk needed to explain a market index such as the S&P 500.

The first two risk factor measures are constructed from time series of returns on portfolios of corporate bonds, government bonds and treasury bills. The first factor measures any unusual spreads between the total monthly returns on corporate bonds and government bonds. The second factor is the spread between total monthly returns on government bonds and treasury bills.

The third and fourth factors are constructed from GNP data. Unexpected inflation is the difference between the rate of inflation expected at the beginning of the month and the actual rate of inflation realized at the end of the month. The fourth factor is the difference between the long-run growth rate in real final sales (profits) expected at the beginning of the month and the long-run growth rate in real final sales (profit) expected at the end of the month. The fifth factor is that part of the S&P 500 return not explained by the other factors.

5.15 Implementing APT

Investment professionals who wish to implement APT in a real life setting can make use of professional software tools developed by companies like APT. APT started in 1985 develops and distributes market- and credit-risk models and software applications.[4] With risk models for every market and asset class, it offers international risk management. APT's integrated, multi-factor risk models are constructed statistically, based on the arbitrage pricing theory, and give accurate risk estimates. Because of their integrated construction method, they are flexible enough for an asset manager to decompose the sources of risk in the fund using the set of factors which are most powerful for the fund – currency, country, sector, style, fundamental, economic, interest rate and user-defined factors. Robust risk profiles for 300,000 equities, government bonds, corporate bonds, currencies, indexes, funds, exchange traded funds, convertibles, commodities, unlimited futures, options, and user-defined securities, provided daily, weekly or monthly. All model estimations are based wholly on the arbitrage pricing theory. Single-country and regional models are available, including World, EAFE, Europe, Eurozone, Emerging Markets, Asia Pacific, etc., and every country with an exchange. Pure electronic, international exchanges are also covered.

Securities and instruments included in the risk models include the following:

- Equities
- Fixed income securities (government bonds, corporate bonds)
- Currencies – *in all models*
- Bond products (convertible bonds)
- Credit products (credit default swaps, CDSs)
- Indexes and futures – *in all models*
- Funds, ETFs and investment trusts

[4] This section is based on the information provided on the company's Web site: www.apt.com

- Property (REITs)
- *User-defined securities*
- Options on any of the items above

Risk factors include the following:

- Statistical factors (components)
- Country factors
- Currency factors
- Sector factors (various popular sector families included)
- Industry factors
- Style factors (value, growth, momentum, etc.)
- Fundamental factors (P/E, P/B, Size, etc.)
- Economic factors (interest rates, price of energy, price of labour, etc.)
- Bond factors (duration, convexity, shift, butterfly, twist)
- *User-defined factors*

APT's range of investment analytics (APTPro, COM Server Toolkit, APTxVar Excel Add-in, APT Optimizer, APT Simulator, APT Raptor and APT Open System Tools) are available on various software platforms, customized to the needs of each class of investment professional.

Likewise, Bell Software and Services Inc. provides a range of tools for implementing CAPM and APT[5]. *PickStock* (copyright 2003, Bell Software and Services, Inc.) uses principal components analysis to search out potentially underpriced stocks by analyzing a user-supplied database of historical stock prices. The program is an implementation of arbitrage pricing theory.

WebCab Portfolio (J2EE Edition) 4.2 helps in applying the Markowitz Theory and CAPM to analyze and construct the optimal portfolio with/without asset weight constraints with respect to Markowitz Theory by giving the risk, return or investors utility function; or with respect to CAPM by given the risk, return or market portfolio weighting. It also includes performance evaluation, extensive auxiliary classes/methods including equation solve and interpolation procedures, analysis of efficient frontier, market portfolio and CML.

5.16 Liquidity and Expected Returns

Although modern finance theory hypothesizes that only systematic risk matters for pricing risky assets, one study in America indicates that portfolios of less liquid stocks provide investors with significantly higher returns, on average, than highly liquid stocks even after adjusting for risk (Amihud and Mendelson, 1988). Why? Investors price securities after considering transaction costs. Given two stocks with same cash flows but with different liquidity, the less liquid stock will trade at lower

[5] http://www.bellsws.com/

prices. Thus, a liquidity premium is attached to illiquid stocks. What this implies is that managers of these companies must earn higher returns than that suggested by CAPM or any asset pricing model to increase shareholder value.

This also implies that managers can increase the value of their companies by increasing the liquidity of the company's stocks and bonds. But increasing liquidity is not costless. For instance, one way to increase liquidity is an initial public offering, which involves underwriting costs. Voluntary disclosure of information is another way to increase liquidity and lessen cost of equity.

5.17 Concluding Comments

There are three principal models of asset pricing – CAPM, APT and FF model. The CAPM is an important idea in finance theory. This chapter introduced several approaches for estimation of expected return on equity for both listed and unlisted firms.

The expected return on equity can be estimated in three ways.

- The CAPM approach
- Dividend discount model
- Risk premium approach

The CAPM is the most widely used model. The systematic risk of a stock, among other factors, depends on operating and financial leverage. The higher the leverage, the higher is the beta.

The strengths and weaknesses of APT are the following:

- The model gives a reasonable description of risk and return
- Factors seem plausible
- There is no need to measure market portfolio
- The model itself does not say what the factors are
- Factors can change over time
- Estimating multifactor models requires more data

With the availability of professional estimates of beta and other factors it is now relatively easier to implement these alternate models in security analysis and investment management.

5.18 End of the Chapter Exercises

1. Explain how risk free rate is calculated in practice.
2. What are the issues in the estimation of beta?
3. Describe the procedure for adjusting beta estimates.
4. Describe the alternate approaches for estimating expected returns.
5. Explain the terms fundamental beta and industry beta.

6. What are the criticisms of CAPM?
7. Explain the differences between the CAPM and FF 3-factor models
8. How is arbitrage pricing theory different from CAPM? Explain the procedure involved in implementing APT in investment management.

References

Amihud Y, Christensen BJ, Mendelson H (1992) Further evidence on the risk-return relationship. Working Paper S-93-11. Salomon Brothers Center for the Study of Financial Institutions, Graduate School of Business Administration, New York University

Berry M, Burmeister E, McElroy M (1988) Sorting out risks using unknown risk factors. Financ Anal J

Black F, Jensen M, Scholes M (1972) The Capital Asset Pricing Model: Some Empirical Tests, in Jensen M ed., Studies in the Theory of Capital Markets. Praeger Publishers

Black F (1993) Estimating Expected return, Financial Analysts Journal, September/October, 49(5):36–38

Booth L (1998) A new model for estimating risk premiums. J Appl Corporate Finance

Booth L (1999) Estimating the equity risk premium and equity costs: new ways of looking at old data. J Appl Corporate Finance

Bower RS, Jenks JM (1975) Divisional screening rates. Financ Manage

Brigham E (1975) Hurdle rates for screening capital expenditure proposals. Financ Manage

Brigham E, Shome DK, Winson SR (1985) The risk premium approach to measuring a utility's cost of equity. Financ Manage

Chambers DR, Harris RS, Pringle JJ (1982) Treatment of financing mix in analyzing investment opportunities. Financ Manage

Chen N.-F, Roll RR, Ross SA (1986) Economic Forces and the Stock Market. Journal of Business 59(3):383–404

Conine TE, Tamarkin M (1985) Divisional cost of capital estimation: adjusting for leverage. Financ Manage

Erb CB, Harvey C, Viskanta T (1996) Expected returns and volatility in 135 countries. J Portfolio Manage

Erhardt MC (1994) The search for value: measuring the company's cost of capital. HBS Press

Fama EF, MacBeth JD (1973) Risk, Return and Equilibrium: Empirical Tests. Journal of Political Economy 81:607–636

Fama EF, French KR (1992) The Cross-Section of Expected Stock Returns. Journal of Finance 47

Fuller RJ, Kerr HS (1981) Estimating the divisional cost of capital: an analysis of pure play technique. J Finance

Fuller R Jr, Hickman K (1991) A note on estimating the historical risk premium. Financ Practice Edu

Harvey CR (1995) Predictable risk and returns in emerging markets. Rev Financ Studies 8

Hawawini G (1983) Why beta shifts as the return interval changes. Financ Anal J

Gitman L, Mercurio VA (1982) Cost of capital techniques used by major US firms: survey and analysis of Fortune's 1000. Financ Manage

Graham JR, Harvey C (2001) The theory and practice of corporate finance: evidence from the field. J Financ Econ 61

Gordon MJ, Halpern P (1972) The cost of capital for a division of a firm. J Finance

Gup B, Norwood S (1982) Divisional cost of capital: a practical approach. Financ Manage

Hamada RS (1972) The effect of the firm's capital structure on the systematic risk of common stocks. J Finance

Harrington D (1983) Stock prices, beta, and strategic planning. Harvard Business Review

Harrington D (1984) Modern portfolio theory and capital asset pricing model. Prentice Hall Inc
Harris RS, O'Brien TJ, Wakeman D (1989) Divisional cost of capital estimation for multi industry firms. Financ Manage
Kothari SP, Shanken J, Sloan RG (1995) Another look at the cross section of expected stock returns. Journal of Finance 50 (March):185–224
Mullins D Jr (1982) Does the capital asset pricing model work? Harvard Business review
Petit J (1999) Corporate capital costs: a practitioner's guide. J Appl Corporate Finance
Roll RR, Ross SA (1980) An Empirical Investigation of the Arbitrage Pricing Theory. Journal of Finance 35:1073–1104
Rosenberg B, Guy J (1976) Prediction of a beta from investment fundamentals. Financ Anal J
Siegel J (1985) The application of the DCF methodology for determining the cost of equity capital. Financ Manage
Yakov A, Haim M (1988) Liquidity and asset prices: financial management implications. Financ Manage
Much of research on behavior of emerging market returns is by Prof. Campbell Harvey. Some papers on the subject are
Erb CB, Harvey C, Viskanta T (1996) Expected returns and volatility in 135 countries. J Portfolio Manage
Erb CB, Harvey C, Viskanta T (1998) Risk in emerging markets. Financ Surv
Erb CB, Harvey C, Viskanta T (1996) Political risk, economic risk and financial risk. Financ Anal J
Beakert G, Harvey C Emerging equity market volatility. Working Paper, Duke University

Chapter 6
Accounting and Financial Analysis

Chandrasekhar Krishnamurti and S.R. Vishwanath

6.1 Chapter Introduction and Objectives

Although regulations limit managerial discretion in financial reporting, managers still have leeway in choosing accounting policies. Consequently, analysts are required to make adjustments to reported results in order to make meaningful comparison of performance of different companies. This chapter highlights the issues in accounting analysis. The chapter also covers techniques of financial analysis like ratio analysis. This chapter has the following objectives:

- Highlight building blocks of accrual accounting
- Highlight why managers make changes in accounting policies
- Highlight factors affecting accounting quality
- Discuss ratio analysis
- Introduce sustainable growth analysis

Shares in troubled healthcare software provider iSoft Group, Plc. fell over 25% in morning trading after the company announced that annual profits would be lower than forecast due to a change in accounting policy (iSoft Shares Slump Again on Accounting Policy Change, 2006). Manchester, UK-based iSoft said that, under a new accounting policy for revenue recognition, pretax profit for the year to 30 April 2006 would be between £3 million ($5.5 million) and £7 million ($12.9 million), compared to earlier estimates of between £17 million ($31.4 million) and £22 million ($40.7 million). The company also lowered its guidance for annual sales to between £195 million ($360.5 million) and £200 million ($369.7 million) from earlier forecasts in the range £210 million ($388.2 million) and £215 million ($397.5 million). iSoft said that it was looking to reduce operating costs by around £30 million ($55.5 million) by the end of the current financial year, and as a result

C. Krishnamurti (✉)
AUT University College of Business, WF Building, Wellesley Campus, 42 Wakefield Street, Auckland 1010, New Zealand
e-mail: Chandrasekhar.krishnamurti@aut.ac.nz

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_6,

it was planning to cut around 150 staff from its UK operation, representing about 15% of total headcount in the UK. The company estimated the cost of this action at around £3 million ($5.5 million). Over the last 6 months, iSoft has been beset by concerns over its contracts with the UK National Health Service. The company is the main application provider on the Accenture-led Northeast and East of England "clusters," and was publicly blamed by Accenture for causing costly delays to the project. In January 2006, iSoft shares on the London stock exchange were trading at just under 400 pence ($7.39). However, a series of sharp falls has pushed the company's share value down to below 100 pence ($1.85) in less than 6 months. Following this latest slump, shares in iSoft were trading at just over 60 pence ($1.11).

Financial statements are reports of business performance of the company during the year. Financial statements are used by different groups of people for different purposes. Lenders are interested in financial statements to assess the credit worthiness of the company; investors are interested in assessing the profit potential, bankers in fixing the working capital limit; academic researchers in the quality of disclosure, etc. Nobody would be as much interested as the managers of the company simply because their personal fortune and jobs are tied to the performance of the company. They would be interested, for example, in assessing the indebtedness of the company and when they come due in relation to cash flow available or the impact of extending credit to customers on the financial condition of the company. The set of analytical tools available is the same regardless of who you are; only the emphasis changes.

A company's management is responsible for anticipating future imbalances in the company's financial system before its severity is reflected in the company's financial statements. The starting point for a financial forecast is the formulation of management goals and product market strategy, which in turn determines the outlook for sales. The firm's strategy and sales growth will determine the investment in fixed assets and working capital to support these strategies. The effectiveness of these strategies coupled with competitive reaction will influence the company's financial performance and future need for finance. Needless to say, future profitability is necessary for access to capital markets.

6.2 Building Blocks of Accrual Accounting

Financial statements try to capture operating performance over a fixed period. Accrual accounting matches expenses incurred during the year with revenue earned, irrespective of cash flows. The financial reporting concept of accounting income is based on the accrual concept. Assume that a company invests in a plant. The investment is then depreciated over the following 25 years. Depreciation is a way of allocating the purchase price over each year of the plant's useful life so that profits can be estimated each year. Cash flows are spent and received in a lumpy pattern and, over the long run, total cash flows do tend to equal total accruals. But in a single year, they are not equal. Depending on how depreciation is estimated and allocated, the net income can be higher or lower in a given year.

Likewise, under the Generally Accepted Accounting Principles (GAAP), sales are recorded when goods are delivered or services are rendered, not when actual cash is received. Accounting Standards Authorities prescribe rules for recognizing revenue in various industry groups.

Under the GAAP, there are two requirements for revenue recognition to occur:

- Completion of the earnings process
- Reasonable assurance of payment

Financial Accounting Standards Board (FASB) Statement No. 5 relating to recognition and measurement in financial statements of business enterprises states that revenue should not be recognized until they are realized or realizable or earned.

Revenues and gains during a period are generally measured by the exchange values of the assets or liabilities involved and recognition involves consideration of two factors – until they are realized or realizable or earned.

Revenues are realized when products, merchandize, or other assets are exchanged for cash or claims to cash. They are realizable when related assets received or held are readily convertible to known amounts of cash or claims to cash.

Revenues are earned when the entity has substantially accomplished what it must do to be entitled to the benefits represented by the revenues.

Since, at one end of the spectrum, in some industry groups, the sales process extends beyond one accounting period (e.g., construction), whereas, in others, cash is received before goods are delivered (e.g., magazines); there has to be alternative criteria for revenue recognition.

Consider the following situations. How should the revenue recognition criteria be implemented for the following situations?

1. Customers pay in advance (e.g., magazine subscriptions, insurance policies, service contracts)
2. Products or services provided over multiple periods (e.g., long-term construction contracts)
3. Credit worthiness of customer is questionable
4. Money-back guarantees for dissatisfied customers (e.g., magazine and textbook publishers)

There are seven revenue recognition methods to account for different types of transactions:

- Recognition at the time the goods are shipped or services are rendered
- Recognition at the time the sale price is collected (installment sales method)
- Recognition at the time the product is completed, but before delivery (i.e., production method)
- Recognition proportionally over the performance of a long-term contract (% of completion method)
- Recognition at the completion of a long-term contract (i.e., completed contract)
- Recognition after the buyer's cumulative cash payments exceed the seller's total costs (cost recovery method)
- Recognition at time of delivery if the sale if made and cash is received prior to delivery or production (delivery method)

Obviously, the method used has a bearing on the estimate of net income for the period. In the absence of specific rules, it would be difficult to compare the performance of two companies that are similar in all respects except their accounting policy. Consequently, we have GAAP.

6.3 Generally Accepted Accounting Principles

GAAP are common set of accounting principles, standards, and procedures that companies use to compile their financial statements. GAAP are a combination of authoritative standards (set by policy boards) and simply the commonly accepted ways of recording and reporting accounting information. GAAP are imposed on companies so that investors have a minimum level of consistency in the financial statements they use when analyzing companies for investment purposes. GAAP cover such things as revenue recognition, balance sheet item classification, and outstanding share measurements. Companies are expected to follow GAAP rules when reporting their financial data via financial statements.

GAAP starts with a conceptual framework that anchors financial reports to a set of principles, such as materiality and verifiability. The basic goal is to provide users with relevant, reliable, and useful information for making good decisions.

That said, keep in mind that GAAP is only a set of standards. There is plenty of room within GAAP for unscrupulous accountants to distort figures. So, even when a company uses GAAP, you still need to scrutinize its financial statements.

As the framework is general, it requires interpretation and often reinterpretation in light of new business transactions. Consequently, there are numerous accounting standards pertaining to every conceivable transaction.

6.4 External Auditing

A financial audit is the examination of financial statements of a firm by an independent third party. It is an independent opinion on whether or not those financial statements are accurate, relevant, and fair. Audits add credibility to the assertions made by a company's management. Financial audits are conducted by practicing accountants/accounting firms.

Audit firms have fiduciary responsibility for investors. Audit firms face the delicate task of providing a true and fair view without running the risk of losing a client. Arthur Andersen LLP, based in Chicago, later named Andersen, was once one of the so-called *Big Five Accounting firms* (the other four are Pricewaterhouse-Coopers, Deloitte, Ernst and Young, and KPMG), performing auditing, tax, and consulting services for large corporations. In 2002, the firm voluntarily surrendered its licenses to practice as Certified Public Accountants in the USA pending the result of prosecution by the Department of Justice over the firm's handling of the auditing of Enron, the energy corporation.

Throughout its history, Arthur Andersen was known for its high standards in the accounting industry. Andersen struggled to balance the need to maintain its faithfulness to accounting standards with its clients' desired to maximize profits. Andersen has been alleged to have been involved in the fraudulent accounting and auditing of worldCom, Enron, Waste Management, and a few other companies. It began winding down its American operations after the indictment.

In plain English, what this suggests is that, while audited financial statements are supposed to provide a true and fair view of the business, at times they may not.

6.5 Why Do Managers Make Changes in Accounting Policy?

Accounting policies are the specific principles, bases, conventions, rules, and practices applied by an entity in preparing and presenting financial statements (IAS 8). A change in accounting estimate is an adjustment of the carrying amount of an asset or liability, or related expense, resulting from reassessing the expected future benefits and obligations associated with that asset or liability.

IAS 8 requires that an entity shall select and apply its accounting policies consistently for similar transactions, other events and conditions, unless a standard or an interpretation specifically requires or permits categorization of items for which different policies may be appropriate. If a standard or an interpretation requires or permits such categorization, an appropriate accounting policy shall be selected and applied consistently to each category.

An entity is permitted to change an accounting policy only if the change

- is required by a standard or interpretation or
- results in the financial statements providing reliable and more relevant information about the effects of transactions, other events, or conditions on the entity's financial position, financial performance, or cash flows (IAS 8.14)

If a change in accounting policy is required by a new International Accounting Standards Board (IASB) standard or interpretation, the change is accounted for as required by that new pronouncement or, if the new pronouncement does not include specific transition provisions, then the change in accounting policy is applied retrospectively (IAS 8.19).

Disclosures relating to changes in accounting policy caused by a new standard or interpretation include the following (IAS 8.28):

- The title of the standard or interpretation causing the change;
- The nature of the change in accounting policy
- A description of the transitional provisions, including those that might have an effect on future periods
- For the current period and each prior period presented, to the extent practicable, the amount of the adjustment
  - For each financial statement line item affected;
  - For basic and diluted earnings per share (only if the entity is applying IAS 33)

- The amount of the adjustment relating to periods before those presented, to the extent practicable
- If retrospective application is impracticable, an explanation and description of how the change in accounting policy was applied

Disclosures relating to voluntary changes in accounting policy include the following (IAS 8.29):

- The nature of the change in accounting policy
- The reasons why applying the new accounting policy provides reliable and more relevant information
- For the current period and each prior period presented, to the extent practicable, the amount of the adjustment
  - For each financial statement line item affected
  - For basic and diluted earnings per share (only if the entity is applying IAS 33)
- The amount of the adjustment relating to periods before those presented, to the extent practicable
- If retrospective application is impracticable, an explanation and description of how the change in accounting policy was applied

Singapore Airlines, for example, reported an increase of $365.3 million in pre-tax profits and $278.9 million in after-tax profits for the period ended 31 March 2006[1] due to the application of new and revised financial reporting standards FRS 16 (relating to Property, Plant, and Equipment), FRS 28 (relating to Investments in Associates), FRS 39 (Financial Instruments: Recognition and measurement), and FRS 102 (Share based payments). FRS 16, which deals with PPE has been revised to require major inspection costs to be capitalized. Accordingly, Singapore Airlines capitalizes a portion of aircraft maintenance and overhaul costs relating to heavy maintenance visits and engine overhauls and depreciates over 4–6 years. Prior to FY 2005–2006, such costs were charged to the profit and loss account. This increased the profit after-tax by $303.9 million.

6.6 Factors Affecting Accounting Quality

The quality of accounting depends on the rigidity of accounting rules, errors in forecasts and estimates, and reporting choices made by the managers.

6.6.1 Accounting Rules

As pointed out earlier, although there are numerous accounting standards and principles, financial statements still come with noise and bias. In many countries,

[1] www.singaporeair.com

companies are required to expense R&D expenditure in the year in which they are incurred. Clearly, some of the R&D projects have long-term value, whereas others do not have. So expensing all expenditure would be inappropriate. Consequently, some performance measurement- and compensation-consulting firms (like Stern Stewart and Co.) who provide EVA (economic value added) consulting make several adjustments to the financial statements to construct a economic balance sheet.[2]

Accounting adjustments can be made either by the company for internal considerations or by analysts to produce more realistic financial statements.

Accounting adjustments are made to produce a balance sheet that reflects economic values of assets in place and remove the effect of managers' focus on current earnings. Stern Stewart and Co., for example, considers about 250 accounting adjustments in moving to EVA. In defining and refining its EVA measure, Stern Stewart and Co. has identified over 120 (!) shortcomings in conventional accounting. In addition to GAAP's inability to handle R&D and other corporate investments, Stern Stewart and Co. has addressed performance measurement problems associated with accounting treatments of inventory costing and valuation, depreciation, revenue recognition, write off of bad debts, mandated investments in safety and environmental compliance, pension and postretirement medical expense, valuation of contingent liabilities and hedges, transfer pricing and overhead allocation, joint ventures and start ups, and special issues of taxation, inflation and currency translation.

6.6.2 Errors in Forecasts and Estimates

Financial statement items like sales and accounts receivable are essentially management estimates because revenues are recorded when there is a reasonable chance that amounts are collected. Managers make estimates of bad debts and make provisions in the financial statements. Since managers cannot predict future perfectly and accurately, it is possible that bad debts can be higher or lower than expected.

6.6.3 Managers' Accounting Choices

Profits and cash flow are a function of accounting choices made by companies. Depending on how firms treat their expenses and assets, profits or cash flow can be higher or lower. Examples of transactions include treatment of good will, depreciation and amortization, employee stock options, hedging, and fixed assets.

Depreciation can be provided either using a straight line basis or accelerated methods (written down value). In the straight line method, the asset is assumed to depreciate at a constant rate over the estimated useful life of the asset.

[2] EVA is discussed in a subsequent chapter.

$$\text{Annual Depreciation} = \frac{\text{Cost of asset} - \text{residual value}}{\text{Useful life}}.$$

Obviously, how residual value (salvage value) and useful life is determined has a bearing on the amount of annual depreciation. It must be noted that even if the pattern of allocation under the two methods is different, the *total* amount of depreciation is the same.

Businesses that adopt accelerated depreciation policies, aggressive depreciation policies, record a lower profit compared to companies that adopt more conservative policies. The lower profits can lead to lower price multiples and a decline in the stock price. The flip side of the coin is that, due to higher depreciation, reported cash flows go up. So, there is a trade off between the two. Depreciating an asset by an accelerated method results in relatively lower taxes early in the asset's life and higher taxes later on as the depreciation tax allowance declines. Some argue that the initial high after tax income is illusory because they must eventually be paid in full. Others maintain that so long as firms continue growing and adding depreciable assets, the tax payment will continue to be deferred.

Depending on the rate and duration of asset growth, and on debt policy, the different accounting treatments produce widely varied patterns of reported profits. Valuation multiples like price/earnings, price/book value are also affected by the choice of accounting policy.

Another subtle influence of using accelerated depreciation methods is that requests for capital investments from divisional managers come in too frequently as and when assets get depreciated driving the company to capital providers every now and then. Further, when products are priced on the basis of full costs, a company's products may become overpriced in markets and, hence, become less competitive.

Just as companies may make changes in accounting numbers for internal purposes, outside analysts may make changes in financial data to produce financial statements that reflect reality more accurately. For example, in the absence of accounting standards for dilutive securities or employee stock options, companies may arbitrarily choose policies that distort financial data. Analysts can undo the effect of such policies by constructing their own statements.

6.6.4 Accounting-Based Debt Covenants

Debt covenants, also called banking covenants or financial covenants, are agreements between a company and its creditors that the company should operate within certain limits. A covenant is an agreement or promise to do or not to do a particular thing, to enter into a formal agreement; a promise incidental to a deed or contract. The functional objectives guiding most covenants are full disclosure of information, preservation of net worth, maintenance of asset quality, maintenance of adequate cash flow, control of growth, control of management, assurance of legal existence and concept of going concern, and provision for lender profit or program goals. Debt covenants are agreed as a condition of borrowing. They may be changed if debt is restructured. The conditions agreed to vary. A company may, for example, agree to limit other borrowing or to maintain a certain level of gearing. Other common limits include levels of interest cover, working capital, and cash flow.

Covenants are of two types: affirmative and negative. Affirmative covenants include the following:

- Use the loan for agreed upon purpose
- Compliance with laws
- Rights of inspection
- Maintenance of insurance, properties, and records

Negative covenants include the following:

- Limit on the total amount of debt
- Limit on the amount of investment and capital expenditure
- Limit on the size of dividend payments

Lenders make use of accounting numbers fixed charge coverage [i.e., Earnings before interest, taxes, depreciation, and amortization (EBITDA)/interest + debt due now + dividends + replacement capex] in debt agreements. Further, they also specify maintenance of a minimum current ratio. Debt covenants can impose quite heavy obligations – a company may well be forced to sell assets in order to stay within a debt covenant on leverage. In theory, breach of a debt covenant usually allows creditors to demand immediate repayment. This rarely happens in practice. The debtor is not usually in a position to make an immediate repayment. A breach of covenants, therefore, usually leads to a renegotiation of the terms of debt. The debt is likely to be renegotiated on worse terms as a quid pro quo for not demanding immediate repayment. Managers have an incentive to manage earnings when contract provisions are about to be violated.

Academic research provides evidence that firms make accounting choices to avoid violation of debt covenant provisions and the resulting costs of technical default. These studies indicate that defaulting firms make more accounting changes than nondefaulting firms. The decision by defaulting firms to change or not change accounting methods during the 3 years ending in the year of a technical default of debt covenants can be explained in part by the ability of the firm and by the incentives of the firm to make a change (Steven et al., 2004).

In order to prevent companies from meeting the requirements by adjusting their accounting practices rather than by genuinely maintaining the required level of financial health, debt covenants not only specify the numbers that should be met but also specify exactly how they should be calculated for the purposes of the debt covenant. This means that if a company breaches, or is in danger of breaching its debt covenants, not only does this indicate that the company is not financially strong but also indicate that the problems are likely to become worse as lenders react.

6.6.5 Management Compensation

In many companies, top management compensation is tied to one or more measures of performance. Quite often earnings before interest and tax or profit after tax or a ratio such as return on equity is used to determine bonus. Clearly, managers have an incentive to distort numbers to maximize their compensation. Of course, it is possible for the board to see through such behavior, which limits the scope for manipulation.

6.6.6 Capital Market Considerations

As demonstrated in the iSoft example presented at the beginning of the chapter, the stock market reacts to financial statement data and changes in accounting policy. Consequently, managers have an incentive to choose policies that increase profits and/or cash flows. This can, at least in the short run, can prop up the stock price. The incentive to keep the stock price up is more when a company's strategy is to grow via acquisitions paid in stock.

6.6.7 Tax Considerations

Managers may also make reporting choices to trade off between financial reporting and tax considerations. As pointed out earlier, depreciating an asset by an accelerated method results in relatively lower taxes early in the asset's life. So managers can reduce taxes by switching from straight line to accelerated methods. Likewise, the LIFO (last-in-first-out) method results in lower profits and, hence, taxes when input prices are rising.

6.7 Performing Accounting Analysis

The following steps are involved in performing an accounting analysis:

- Identify key accounting policies: All accounting policies are not significant in all industry groups. Analysts must prepare a list of all key accounting policies relevant to the company and industry in which the company operates, and make an estimate of the impact of key accounting policies. In the airlines industry, for example, accounting for long-lived assets and depreciation are important. Likewise, how inventory is accounted for is important in retailing.
- Evaluate accounting policy and the quality of financial disclosure: Analysts can (and must) compare the policies of a firm with those of peer companies to find out the firm's incentives in choosing the policies.
- Make adjustments for accounting distortions by restating balance sheet, income statement, and cash flow statement numbers.

6.8 Financial Analysis

Financial statements reflect the nature of the industry, the company's competitive position, and policies. The financial statements of Amazon.com, for example, would be different from those of more traditional brick and mortar companies. To begin with, Amazon's business model is such that it carries very little inventory compared to land-based retailers; it has little or no receivables (it receives money *before* it ships books) and so on. Likewise, Airline firms invest heavily in plant and equipment. Consequently, depreciation would be high. Software firms derive much of their value from future growth options and intangibles like human capital and indirect costs of bankruptcy are high. So they carry little or no debt because of lack of hard asset collateral. The objective of financial analysis is to assess the performance of a firm in relation to the stated goals, strategy, and those of competition. There are two principal methods of financial analysis:

- Ratio analysis
- Analysis of cash flow statements

We discuss ratio analysis in this chapter. The subsequent chapter is devoted to analysis of cash flow.

6.8.1 Ratio Analysis

A ratio is a relationship between two numbers. Managers and analysts use a variety of balance sheet and income statement ratios to assess the financial health of a company. These ratios can be classified as follows:

- Liquidity ratios
- Coverage ratios
- Leverage ratios
- Operating ratios
- Profitability ratios

In the News

Investor anger surfaced last week after Red Hat, Inc., changed how it books software subscription revenue, setting the stage for courtroom battles on whether company officials profited from the switch in accounting methods (Babcock, 2004). Investors filed six class-action lawsuits against the Linux supplier 2 days after it said it would restate earnings and move to a daily, instead of monthly, method of accounting for its software subscription revenue. The suits charge company executives with violating various infractions of securities laws and misleading of investors. One suit charged that company officials profited from the sale of stock between March 19, 2002, and last Monday, when the monthly accounting method was in force. Red Hat did not respond to a request for a comment. Red Hat shares, which hit a 4-year high of $29.06 in June, closed at $15.15 on Friday, down $5.34 for the week, or 26%. Until Thursday, when shares rose slightly, the stock had been on a slide since the unexpected resignation of chief financial officer (CFO) Kenneth Thompson on June 14, followed by lower-than-expected earnings projections on June 17. Monthly accounting of subscription revenue is more common among software companies than daily accounting. Daily-based accounting is a "more-conservative method," says Dion Cornett, Managing Director at the equity-research firm Decatur Jones Equity Partners LLC. The shift to daily from monthly revenue accounting for subscriptions has the effect of moving revenue that was previously recognized in the first quarter of a subscription into the final quarter of the agreement, Red Hat officials said. The firm's auditors, PricewaterhouseCoopers, recommended the change in June.

Exhibit 6.1 Time series of Return on Equity (*ROE*) for Toyota

Year	ROE %
2007	14.7
2006	14.0
2005	13.6
2004	15.2

Source: Toyota

Measuring Overall Profitability

The starting point for the analysis of a firm's financial efficiency is return on equity (ROE) (or ROI, return on investment). They measure the efficiency with which the firm employs capital – be it owner's capital or total capital. Accordingly, there are two commonly used measures – ROE and ROI, depending on from whose viewpoint you are analyzing.

Return on equity is measured as the ratio of earnings available for shareholders and net worth, that is,

$$\text{ROE} = \frac{\text{Profit after Tax} - \text{Preference Dividend (if any)}}{\text{Net worth}}.$$

This ratio measures the efficiency with which the firm employs owner's equity. It estimates profits per dollar of shareholder's funds.

Exhibit 6.1 shows the ROE for Toyota, Japan.

As can be seen from the table, ROE has declined for Toyota but is recovering. But that itself does not tell us the whole story. Because the numerator (net income) is an unreliable measure of performance, the outcome of the formula must also be unreliable. More specifically, the numerator is susceptible to accounting policies chosen by the company.

Decomposing Profitability: DuPont Approach

Return on equity is measured as the ratio of net income and book value of equity.

$$\text{ROE} = \frac{\text{Net income}}{\text{B.V. of Equity}}.$$

The ratio can be decomposed into three components:

$$\begin{aligned} &= \frac{\text{Net income}}{\text{Sales}} \times \frac{\text{Sales}}{\text{Assets}} \times \frac{\text{Assets}}{\text{Equity}}, \\ &= [\text{Profit margin}] \times [\text{Asset turnover}] \times [\text{Financial leverage}]. \end{aligned}$$

ROE itself is a function of profit margin, asset turnover, and financial leverage. Increasing any of these would lead to an increase in ROE. Net profit margin is the profit a company makes for every dollar it generates in revenues; asset turnover is the amount of sales generated for every dollar worth of assets; and leverage is the extent of debt in a firm's capital structure.

This decomposition of ROE into its component ratios is termed DuPont analysis. The DuPont model is a technique that can be used to analyze the profitability of a company using traditional performance management tools. The DuPont model of financial analysis was made by Donaldson Brown, an electrical engineer with DuPont in 1919.

For example, assume the following for a company:

Net income = \$2,592,000
Sales = \$21,244,000
Assets = \$132,616,000
Equity = \$9,744,000

Net profit margin = \$2,592,000/\$21,244,000 = 12.2%
Asset turnover = \$21,244,000/\$132,616,000 = 0.16
Leverage = \$132,616,000/\$9,744,000 = 13.6

ROE = 26.6%

Decomposing ROE into its components throws light on the behavior of each of the component ratios over a period.

$$\frac{\text{EBIT}}{\text{Assets}}$$

$$\frac{\text{EBIT}}{\text{Sales}} \quad \mathbf{X} \quad \frac{\text{Sales}}{\text{Asset}}$$

or

$$\text{Return on Assets} = \frac{\text{Pretax profit}}{\text{Sales}} \times (1 - \text{Tax rate}) \times \frac{\text{Sales}}{\text{Assets}}.$$

Performing DuPont analysis is not that simple. How should return on assets (ROA) be measured? That is, what variables should be used in the numerator and denominator? Earnings before interest and taxes (EBIT), earnings before interest after taxes (EBIAT), profit before tax (PBT), and profit after tax (PAT) are all candidates for the numerator. Likewise, total assets and net assets (net of current liabilities) are candidates for the denominator. Further, the ratio itself has been referred to by a number of different names – return on assets, return on capital employed, return on investment, and so on. The most consistent definition of return on assets is

$$\mathrm{ROA} = \frac{\mathrm{EBIT}}{\text{Net Assets}},$$

where Net Assets = Fixed Assets + Net working Capital (excluding short-term debt).

Certain types of retail establishments, particularly grocery stores, may have very low profit margins on sales, and relatively moderate leverage. In contrast, though, groceries may have very high turnover, selling a significant multiple of their assets per year. The ROE of such firms may be particularly dependent on performance of this metric, and, hence, asset turnover may be studied extremely carefully for signs of under- or over-performance.

Other industries, such as fashion, may derive a substantial portion of their competitive advantage from selling at a higher margin, rather than higher sales. For high-end fashion brands, increasing sales without sacrificing margin may be critical. The DuPont identity allows analysts to determine which of the elements is dominant in any change of ROE.

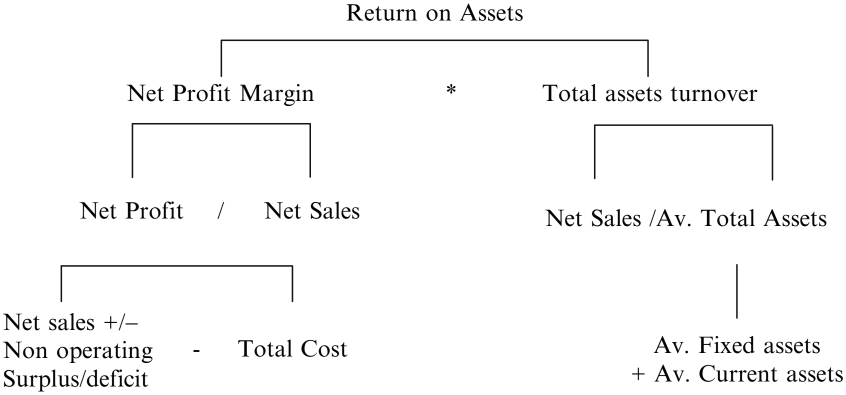
Some sectors, such as the financial sector, rely on high leverage to generate acceptable ROE. In contrast, however, many other industries would see high levels of leverage as unacceptably risky. DuPont analysis allows the third party (relying primarily on the financial statements) to compare leverage with other financial elements that determine ROE between similar companies.

Exhibit 6.2 presents a generic DuPont chart.

Decomposing Profitability: Alternative Approach

As pointed out earlier, performing DuPont analysis the way it was outlined above has certain limitations. The numerator has net income, which flows to shareholders whereas the denominator in the computation of ROA has total assets. Further, net

Exhibit 6.2 DuPont chart



income contains interest expense and income that are consequences of financing decisions and assets include both operating and financial assets. It is often useful to separate the two sources (i.e., operating and financing).

Another approach to linking ROE and ROA is given below.

$$\text{ROE} = \left[\text{ROA} + \frac{D}{E}\{\text{ROA} - i(1-T)\}\right],$$

where,

$i =$ interest rate on debt
$T =$ tax rate
$D/E =$ debt – equity ratio
ROA $=$ EBIT $(1-T)$/book value of total capital

Injecting debt will increase the actual return on equity as long as ROA is greater than the after-tax cost of debt by an amount

$$\frac{D}{E}[\text{ROA} - i(1-T)].$$

Every firm has three value drivers: profitability, advantage horizon, and reinvestment. Profitability refers to the spread between return on equity and cost of equity. Those firms that generate positive spreads are expected to sell at market-to-book ratios of greater than 1; those that do not would sell at below 1. In other words, the value of ROE derives meaning only when compared with the cost of equity for the firm.

The length of time for which a firm can maintain a positive spread is the advantage horizon. The length of advantage horizon depends on many factors like state of competition, flexibility in pricing, rate on new product introduction, changes in interest rates, systematic risk of the firm's equity, etc. The abnormal returns dissipate over a period of time due to competition. That is, over longer time horizons, return on equity falls to cost of equity.

6.9 Assessing Operating Management: Decomposing Net Profit Margins

One of the measures of operational efficiency is the net profit margin measured as the ratio of net profit margin and sales. It is the profit generated for every dollar of sales. Obviously, we would expect substantial variation in profit margins across industry groups and companies within the same industry (see Exhibit 6.3 for example). The degree of profitability depends on a variety of factors like degree of competition, type of product, extent of regulation, input costs, strategy followed by the company, and so on.

Exhibit 6.3 Profit margins in the utilities industry in the USA in 2007 (in %)

Ratio	AES	Company constellation	Beacon power
Operating margin	25.78	7.19	−1058.94
Profit margin	−4.30	5.23	NA

Analysts often prepare common size balance sheet and income statements by dividing each entry (in the relevant statement) by a common denominator such as total assets and sales, respectively. The objective of preparing common size balance sheet and income statement is to ascertain the trends in proportions. For instance, if total currents have grown from 10% of total assets to 15% between the last year and the current year, one can investigate the reasons for changes in proportion. Likewise, one can express EBITDA, NOPAT (net operating profit after tax but before interest), and EBIT as fraction of sales to ascertain the impact of depreciation, interest expense, tax expense, and selling, general, and administrative expenses on the net profit margin.

This analysis throws light on the company's ability to manage its expenses well in the light of the company's strategy. One could examine the impact of each line item in the income statement on the profit margins.

6.9.1 Evaluating Investment Management: Decomposing Asset Turnover

One of the determinants of ROE is asset turnover calculated as the ratio of sales and assets. As pointed out earlier, total assets and net assets (net of current liabilities) are candidates for the denominator.

$$\text{Net Assets} = \text{Fixed Assets} + \text{Net working Capital}\ (\text{excluding short-term debt}).$$

Evaluating the components of assets, that is, fixed and current would throw light on the behavior of the asset turnover ratio. While generating higher sales for each dollar of assets employed is generally good, excessive sales are not. That is, when the ratio is high, a firm is said to be over trading and is not likely to be sustainable. Likewise, lower sales are considered under trading.

To complete the analysis one can look at a whole lot of ratios relating to working capital management, like receivables turnover inventory turnover, etc, to ascertain the exact reason for under or over trading. Shorter or negative operating cycles lead to higher sales for the same level of assets. But beyond a certain point the increase in sales is unsustainable.

6.9.2 Evaluating Financial Management: Financial Leverage

One of the jobs of the CFO is to maintain contact with capital markets and raise adequate resources at acceptable prices. One of the goals of financial analysis is to ascertain whether a firm has too much or too little debt. As pointed out earlier, judicious employment of debt will result in an increase in ROE and stock price.

To reiterate the point made earlier about judicious employment of debt we tell you a small story. My grandmother, a conservative lady, kept saying borrowing is bad. She never borrowed and she died penniless. Take out the financial statements of any company run by the rich and famous. You will see that they have borrowed in millions. But most of them will die a millionaire. The moral of the story is that the issue is not whether you borrowed or not but what you did with it.

Increasing financial leverage is beneficial only up to a certain extent. Reckless borrowing will destroy shareholder value.

Conventional wisdom suggests that companies should avoid combining high operating leverage (which leads to high business risk) and high financial leverage (which leads to high financial risk). Earnings are boosted in good times because of the presence of fixed costs and debt, but (earnings) get depressed in bad times for the same reason viz. presence of interest payments on debt and other fixed costs. Massey Ferguson, a multinational producer of farm machinery, industrial machinery, and diesel engines sought to increase its market share by turning to the Third world for growth. Massey manufactured its products in UK and Canada and sold the output to LDCs (less-developed countries) in the late 1970s. This strategy worked quite well in the initial years. Compared with competitors Massey had an aggressive debt policy *and* an aggressive product–market strategy. It coupled a risky strategy in a cyclical industry with high (short-term) debt.[3] When short-term interest rates shot up and the demand (and hence revenue) dried up for its products for various reasons, Massey was thrown into distress. John Deere, its major competitor, however, had moderate debt ratio because of which it had the financial flexibility to make capital investments. When Massey and another competitor International Harvester were busy resolving distress, Deere pursued aggressive tactics to lock up market share.

Many steel companies in Asia are (were) highly leveraged and depend(ed) on high tonnages to survive. When the Asian economies shrank during the East Asian financial crisis in the mid 1990s, these companies were badly affected. This trend is not specific to the steel sector. A survey of the five countries most affected by the East Asian financial crisis – Indonesia, the Republic of Korea, Malaysia, the Philippines, and Thailand – found that 63% of firms are illiquid (with earnings less than debt service) and 31% technically insolvent (with financial obligations exceeding their equity) (Classens 1999). For the entire period 1988–1996, the average debt ratios in Korea and Thailand were much higher than that in Germany and the USA.

[3] Customers in less developed countries are more risky compared to customers in developed countries.

East Asian firms had not only too much debt but also the wrong type of debt viz. short term. The average share of short-term debt in total debt was about 66% in Malaysia and Thailand in contrast with 25% in the USA and 45% in Germany. In addition, Korean and Malaysian firms had substantial share of foreign currency short-term debt. When the domestic currency is devalued, the value of foreign currency debt (denominated in, say, US dollars) increases. Sovereign governments may increase interest rates to stabilize their currencies. But this has a negative impact on corporate profitability.

In determining the financial soundness of a company one must ascertain whether a company's debt policy is prudent. Just as shareholders in companies with too much debt have one set of problems; those in companies with too little have another set viz. free cash flow problem. In those companies with substantial free cash flow and limited growth opportunities, shareholders would be better off by receiving higher dividends funded with debt.

Analysts (especially credit) and rating agencies like Standard and Poor's (S&P) calculate several leverage ratios like interest coverage, debt service coverage long-term debt to capital ratio, etc. in rating long-term debt issued by firms. Credit ratings are supposed to reflect the ability and willingness of a firm to repay debt. Though rating agencies claim several qualitative factors in addition to ratios play a role in the rating process, it is usually possible to predict ratings on the basis of financial ratios alone. Exhibit 6.4 presents the median ratios for different rating categories of S&P for the period 1998–2000.

Since the cost of debt and, hence, the cost of capital is a function of ratings, which in turn depends on ratios, leverage plays a crucial role in the analysis.

6.9.3 *Bringing Them All Together: Sustainable Growth Rate*

Define sustainable growth for those companies that have a target payout ratio and capital structure as the annual percentage increase in sales that is consistent with the firm's established financial policies.

Exhibit 6.4 Key industrial financial ratios

US long term debt three year 1998–2000 medians	AAA	AA	A	BBB	BB	B	CCC
EBIT interest coverage (x)	21.4	10.1	6.1	3.7	2.1	0.8	0.1
EBITDA interest coverage (x)	26.5	12.9	9.1	5.8	3.4	1.8	1.3
Free operating cash flow/total Debt %	84.2	25.2	15.0	8.5	2.6	(3.2)	(12.9)
Long term debt/total capital %	13.3	28.2	33.9	42.5	57.2	69.7	68.8
Total Debt/total capital %	22.9	37.7	42.5	48.2	62.6	74.8	87.7

Source: Standard & Poor's

Let

$p =$ the profit margin on existing and new sales
$d =$ the target payout ratio
$(1-d) =$ retention ratio
$L =$ target debt – equity ratio
$S =$ sales at the beginning of the year
ds $=$ increase in sales during the year

The increase in sales is preceded by an increase in asset base. The increase in asset base can be financed by retained earnings, new debt, or new equity. If we assume that the firm is unable or unwilling to sell new equity, the option reduces to retained earnings or new debt. Since the firm has a target debt, equity ratio to maintain, the increase in debt has to be proportional to the increase in retained earnings. So under stable conditions, increase in sales is determined by retained earnings.

$$\text{Increase in sales} = \text{Addition to retained earnings} + \text{Increase in debt},$$

$$\begin{aligned}\text{Sustainable growth } g &= \frac{\text{Change in equity during the period}}{\text{Beginning}}\\ &= \frac{(\text{Retention rate} \times \text{Earnings})}{\text{Beginning equity}}\\ &= \text{Retention rate} \times \left(\frac{\text{Earnings}}{\text{Beginning equity}}\right)\\ &= \text{Retention rate} \times \text{ROE}\end{aligned}$$

But

$$\begin{aligned}\text{ROE} &= \frac{\text{PAT}}{\text{Equity}},\\ &= \left[\frac{\text{PAT}}{\text{Sales}}\right] \times \frac{\text{Sales}}{\text{Assets}} \times \frac{\text{Assets}}{\text{Equity}},\end{aligned}$$

that is,

$$g = \text{Retention rate} \times \left[\frac{\text{PAT}}{\text{Sales}}\right] \times \left[\frac{\text{Sales}}{\text{Assets}}\right] \times \frac{\text{Assets}}{\text{Equity}}.$$

Sustainable growth is a function of return on assets, retained earnings, and financial leverage.

$$g = \text{retention rate} \times \text{ROE}.$$

Once the sustainable growth rate is calculated, then it should be compared to the firm's actual growth rate. If sustainable growth is greater than actual growth, the firm might be underperforming. If the actual growth rate is greater than sustainable growth, the company may run into trouble because of unrestrained growth.

If sustainable growth is less than actual growth over a protracted period, the company cannot sustain such activity without "funding" that growth. Either they need to plow more profits into the company, increase net profit margin or turnover performance, or "fund" from risky sources, such as increasing the debt level. When sustainable growth is greater than actual growth, the company has the potential of ratcheting up growth. If they consistently fall below sustainable growth, they are passing up returns for shareholders.

$$\text{Sustainable growth rate } g = (1-d)\left[\text{ROA} + \frac{D}{E}\{\text{ROA} - i(1-T)\}\right],$$

where

$i =$ interest rate on debt
$T =$ tax rate
$D/E =$ debt $-$ equity ratio
ROA $=$ EBIT $(1 - T)$/book value of total capital.

Sustainable growth can be increased by injecting debt. Injecting debt will increase the actual return on equity as long as ROA is greater than the after-tax cost of debt by an amount

$$\frac{D}{E}[\text{ROA} - i(1-T)].$$

But the systematic risk of the stock and, hence, expected return increase with leverage.

According to the Capital Asset Pricing Model,

$$\text{Expected return} = R_{\text{f}} + \beta_{\text{L}}[\text{E}(R_{\text{M}}) - R_{\text{f}}]. \tag{6.1}$$

The relationship between levered and unlevered beta is

$$\beta_{\text{L}} = \beta_{\text{U}}\left[1 + (1-T)\frac{D}{E}\right], \tag{6.2}$$

(i.e., leverage increases beta)
where

$\beta_{\text{U}} =$ unlevered beta of the stock (equity beta when the company has no debt) and
$\beta_{\text{L}} =$ levered beta of the stock (equity beta when the company has debt).

Given the beta at the current level of debt β_{L}, the unlevered beta of the stock can be calculated as

$$\beta_{\text{U}} = \frac{\beta_{\text{L}}}{[1 + (1-T)D/E]}. \tag{6.3}$$

The new beta, after increasing leverage, could be estimated using (6.2). The new beta can be plugged in the CAPM to arrive at the new expected return.

After quantifying change in required return (cost of equity) due to increase in beta and actual return due to injecting debt, the percentage change in value can be calculated as follows:

$$\text{Percent change in value} = \left[\left(\frac{\text{PV of increased return}}{\text{PV of existing return}}\right)\right] - 1 \times 100.$$

If we assume that the stream of returns is a growing perpetuity, the present value of returns reduces to

$$\left[\frac{\text{Return}}{k - g}\right],$$

where $k =$ cost of equity and $g =$ sustainable growth in equity.

It should be noted that the increase in actual return should be more than the increase in expected return (cost of equity) for value to increase.

6.10 Concluding Comments

In this chapter, we outlined some popular ways of ascertaining the quality of accounting and earnings. We also demonstrated how financial analysis can be performed to answer important questions regarding the operating and financial efficiency of a firm. The goal of financial analysis is to evaluate the current and past performance and to assess the sustainability. The next chapter introduces analysis of cash flow statements, another important source of information for analysts. Together they help analysts in taking a view on the company's financial condition.

A glossary of some important ratios is presented at the end of the chapter.

Appendix: Glossary of Ratios

1. EBIT Interest Coverage =
$$\frac{\text{Earnings from continuing operations before interest and taxes}}{\text{Gross sinterest incurred before subtracting capitalized interest and interest income}}.$$

2. EBITDA Interest Coverage =
$$\frac{\text{Earnings from continuing operations before interest, taxes, depreciation and amortization}}{\text{Gross interest incurred before subtracting capitalized interest and interest income}}.$$

3. $\frac{\text{Funds from operations}}{\text{total debt}} =$

$$\frac{\text{Net income from continuing operations plus depreciation, amortization, deferred income taxes, and other non cash items}}{\text{Long term debt plus current maturities, commercial paper and other short term borrowings}}.$$

4. $\frac{\text{Free operating cash flow}}{\text{total debt}} =$

$$\frac{\text{Funds from operations minus capital expenditure, minus (plus) the increase (decrease) in working capital (excluding changes in cash and equivalents and short term debt)}}{\text{Long term debt plus current maturities, commercial paper and other short term borrowings}}.$$

5. Return on capital =

$$\frac{\text{EBIT}}{\text{Average of beginning of year and end of year capital, including short debt, current maturities, long term debt, non current deferred taxes and equity}}.$$

6. $\frac{\text{Operating income}}{\text{sales}} =$

$$\frac{\text{Sales minus cost of goods manufactured (before depreciation and amortization), SGA and R\& D costs}}{\text{Sales}}.$$

7. $\frac{\text{Long-term debt}}{\text{capital}} =$

$$\frac{\text{Long-term debt}}{\text{Long-term debt+shareholder's equity (including preferred stock) plus minority interest}}.$$

8. $\frac{\text{Total Debt}}{\text{Capital}} =$

$$\frac{\text{Long-term debt plus current maturities, commercial paper and other short-term borrowings}}{\text{Long-term debt+shareholder's equity (including preferred stock) plus minority interest}}.$$

6.11 End of the Chapter Questions and Exercises

1. What are some reasons managers make changes in accounting policy?
2. What are the factors affecting accounting policy?
3. What are the steps involved in accounting analysis?
4. What are the techniques of financial analysis?

5. Describe the major categories of financial ratios that analysts use to perform financial analysis.
6. Explain the DuPont methodology for decomposing ratios.
7. What is sustainable growth and how is it useful?
8. Liquidity ratios measure the firm's

   (a) ability to cover current obligations.
   (b) ability to cover long-term debt obligations.
   (c) activity level relative to amount of resources used.
   (d) profits relative to amount of resources used.
   (e) market price relative to assets or earnings.

9. Leverage ratios measure the firm's

   (a) ability to cover current obligations.
   (b) ability to cover long-term debt obligations.
   (c) activity level relative to amount of resources used.
   (d) profits relative to amount of resources used.
   (e) market price relative to assets or earnings.

10. Turnover ratios measure the firm's

   (a) ability to cover current obligations.
   (b) ability to cover long-term debt obligations.
   (c) activity level relative to amount of resources used.
   (d) profits relative to amount of resources used.
   (e) market price relative to assets or earnings.

11. Profitability ratios measure the firm's

   (a) ability to cover current obligations.
   (b) ability to cover long-term debt obligations.
   (c) activity level relative to amount of resources used.
   (d) profits relative to amount of resources used.
   (e) market price relative to assets or earnings.

12. Valuation ratios measure the firm's

   (a) ability to cover current obligations.
   (b) ability to cover long-term debt obligations.
   (c) activity level relative to amount of resources used.
   (d) profits relative to amount of resources used.
   (e) market price relative to assets or earnings.

6.12 Exercises

Answer the questions 13–21 based on the following simplified financial statements of a company.

Annual Income Statement (in Millions)	**Dec-99**
Sales	87,548.00
Cost of Sales	49,034.00
Selling, General & Admin. Expense	20,002.00
Dep. & Amort.	6,585.00
Other Income, Net	557
Interest Expense	727
Pre-tax Income	11,757.00
Income Taxes	4,045.00
Net Income	7,712.00

Assets	**Dec-99**	**Dec-99**	**Liabilities & Equity**	**Dec-99**	**Dec-98**
Cash and Equivalents	5,043.00	5,375.00	Accounts Payable	6,400.00	6,252.00
Receivables	27,618.00	26,781.00	Short Term Debt	14,230.00	13,905.00
Inventories	4,868.00	5,200.00	Other Current Liabilities	18,948.00	16,670.00
Other Current Assets	5,626.00	5,004.00	Total Current Liabilities	39,578.00	36,827.00
Total Current Assets	43,155.00	42,360.00			
Property, Plant & Equipment, Net	17,590.00	19,631.00	Long Term Debt	14,124.00	15,508.00
Intangibles	0	945	Deferred Income Taxes	1,354.00	1,514.00
Other Non-Current Assets	26,750.00	23,164.00	Other Non-Current Liabilities	11,928.00	12,818.00
Total Non-Current Assets	44,340.00	43,740.00	Total Non-Current Liabilities	27,406.00	29,840.00
			Total Liabilities	66,984.00	66,667.00
			Share holder's Equity	20,511.00	19,433.00
Total Assets	87,495.00	86,100.00	Total Liabilities & Stock Equity	87,495.00	86,100.00

13. The ROE (measured on an end-of-year basis) in 1999 was

   (a) 8.81%
   (b) 37.60%
   (c) 38.62%
   (d) 57.32%

14. The ROA (measured on an end-of year basis) in 1999 was

   (a) 8.81%
   (b) 8.89%
   (c) 8.96%
   (d) 37.60%

15. The current ratio in 1999 was

    (a) 0.917
    (b) 1.000
    (c) 1.090
    (d) 1.306

16. The quick ratio in 1999 was

    (a) 0.123
    (b) 0.967
    (c) 1.034
    (d) 1.618

17. The total debt ratio in 1999 was

    (a) 0.306
    (b) 0.324
    (c) 0.766
    (d) 3.266

18. The net profit margin in 1999 was

    (a) 8.81%
    (b) 13.43%
    (c) 14.25%
    (d) 42.99%

19. If the EPS was $4.10 and the dividend was $0.52, the retention ratio in 1999 was

    (a) 0.123
    (b) 0.873
    (c) 1.000
    (d) 1.145

20. The total asset turnover ratio (based on end-of-year numbers) in 1999 was

    (a) 0.506
    (b) 0.991
    (c) 0.999
    (d) 11.345

21. The inventory turnover ratio (based on sales and end-of-year numbers) in 1999 was

    (a) 0.056
    (b) 1.060
    (c) 17.984
    (d) 20.295

6.13 Questions on the Interpretation of Financial Ratios and Evaluation the Company's Performance

22. Which of the following would cause Net Worth to increase?

    (a) One of the firm's customers pays an outstanding bill with cash.
    (b) The firm uses cash to pay off a bank note.
    (c) The firm pays a cash dividend to its stockholders.
    (d) The firm sells inventory for a profit.

23. If IBM's quick ratio exceeds 1, then

    (a) IBM can pay off all its current obligations if it liquidates its inventory.
    (b) IBM can pay off all its current obligations even if sales cease.
    (c) IBM has more current liabilities than current assets.
    (d) IBM has more current liabilities than current assets if you subtract inventories.

24. If you find that a company's ratio for a particular item (e.g., the company's debt ratio) is higher than the industry average, this is

    (a) good for the company.
    (b) bad for the company.
    (c) can be either of the above.
    (d) none of the above.

25. The fraction of a firm owned by equity holders is given by

    (a) 1/(debt ratio)
    (b) 1-(debt ratio)
    (c) (equity ratio)/(debt ratio)
    (d) cannot be determined by the debt ratio.

26. All else constant, a surprise announcement that shows a higher ROE for a firm that is expected to remain after it is announced should

    (a) result in a higher than expected return for the company's stock.
    (b) result in a lower than expected return for the company's stock.
    (c) not affect the company's stock.
    (d) lead to the invalidation of the DuPont method.

27. A higher retention ratio should lead to

    (a) lower current dividends.
    (b) higher sustainable growth.
    (c) higher future dividends.
    (d) all of the above.

28. A higher profit margin results from

    (a) lower assets.
    (b) lower expenses.

(c) lower taxes
(d) lower interest.

29. All else constant, a higher asset turnover ratio should lead to

(a) less efficient operations.
(b) lower profits.
(c) more assets required.
(d) all of the above.
(e) none of the above.

6.14 Questions on DuPont Analysis

30. DuPont analysis shows

(a) how profit margin, asset turnover ratio, and equity multiplier determine ROE
(b) how expense control, efficient use of assets in production and capital structure affect return on equity.
(c) production and financing aspects of firm are tied together
(d) all of the above.
(e) none of the above.

31. According to DuPont analysis, an increase in the profit margin (all else constant) should

(a) increase both ROE and ROA.
(b) increase ROE but not ROA.
(c) increase ROA but not ROE.
(d) increase neither ROA nor ROE.

32. According to DuPont analysis, an increase in asset turnover (all else constant) should

(a) increase both ROE and ROA.
(b) increase ROE but not ROA.
(c) increase ROA but not ROE.
(d) increase neither ROA nor ROE.

33. According to DuPont analysis, an increase in the equity multiplier (all else constant) should

(a) increase both ROE and ROA.
(b) increase ROE but not ROA.
(c) increase ROA but not ROE.
(d) increase neither ROA nor ROE.

34. In 1999, IBM's equity multiplier was 4.266, its asset turnover was 0.999 and its net profit margin was 0.088. According to the DuPont method, the ROE should be

  (a) 8.791%.
  (b) 37.503%.
  (c) 37.541%.
  (d) 426.173%.

35. In 1999, IBM's equity multiplier was 4.266, its asset turnover was 0.999 and its net profit margin was 0.088. According to the DuPont method, the ROA should be

  (a) 8.791%.
  (b) 37.503%.
  (c) 37.541%.
  (d) 426.173%.

References

Babcock C (2004) Investors sue after red hat changes accounting policy. Information Week

Ball R (1972) Changes in accounting techniques and stock prices. J Account Res Suppl

Classens S, Djankov S, Ferri G (1999) Corporate distress in east asia: the effect of currency and interest rate shocks. Private Sector

Daley LA, Vigeland RL (1983) The effects of debt covenants and political costs on the choice of accounting methods: the case of accounting for R&D costs. J Account Econ, December

Dharan B, Lev B (1993) The valuation consequence of accounting changes: a multi year examination. J Account Audit Finance, Fall

Dharan B, Mascarenhas B (1992) Determinants of accounting change: an industry analysis of depreciation change. J Account, Audit Finance, Winter

Gibbins M, Richardson AJ, Waterhouse J (1990) The management of corporate financial disclosure: opportunism, ritualism, policies, and processes. J Account Res 28(1):121–143

Healy P (1985) The effect of bonus schemes on accounting decisions. J Account Econ, April

Lev B (1992) Information disclosure strategy. California Manage Rev 34(4):9–32

Palepu K (1987) The anatomy of accounting change. In Bruns WJ, Kaplan RS (eds.) Accounting and management: field study perspectives. Harvard Business School Press, Boston, MA

iSoft shares slump again on accounting policy change (2006) Computer Business Review Online, June 9

Steven CH, Swinney LS (2004) Accounting policy changes and debt contracts. Manage Res News 27(7)

Chapter 7
The Use (and Misuse) of Cash Flow Statements

S.R. Vishwanath

7.1 Chapter Introduction and Objectives

Analysts are required to analyze financial reports of the companies they track. One of the key elements of analysis is the analysis of cash flow statements. Cash flow statements throw light on the operating, investment, and financing decisions of a firm. A careful analysis of cash flow statement enables an analyst to pinpoint "good news" and "bad news" as well as draw overall conclusion.

This chapter has the following objectives:

- Highlight why analysts focus on cash flows
- Explain the structure of a cash flow statement
- Present a framework for analyzing cash flow statements

A balance sheet gives us the snapshot of the financial condition of a firm measured on a particular date (say financial closing date). It is a stock concept. An income statement, on the contrary, is a flow concept. It tells us how the owners' equity changed during the accounting year. A third statement, called the funds flow statement, shows the sources from which funds were raised between two balance sheet dates and how they were deployed. Funds flow statement is also called statement of changes in financial position. It enables us to answer such questions as the following:

- How did the firm finance capital expenditure? Was it by way of equity or debt or some combination?
- How is the firm financing its dividend payments? How was it possible to distribute dividends in excess of profits for the current year?
- Is the company building up or slashing down inventory?

S.R. Vishwanath
Institute of Management Technology, 603, Khullar Apartments, Byramji Town, Nagpur 440001, India
e-mail: srvishy@gmail.com

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_7,

7.2 Preparation of Funds Flow Statement

All increases in liabilities and decreases in assets are sources of funds and all decreases in liabilities and increases in assets are uses (application) of funds. Source of funds will always be equal to uses of funds. To prepare a funds flow statement, place two balance sheets of two dates side and side and note down all changes. Then segregate them into sources and uses of funds.

The sources of funds are the following:

1. Net income
2. Funds from depreciation
3. Issue of capital stock in cash
4. Term loans from FIs, proceeds from selling debentures, public deposits
5. Sale of fixed assets and investments
6. Reduction in other assets (current and noncurrent)
7. Decrease in marketable securities
8. Increase in notes/accounts payable/deferred tax/employee benefits/deferred credits

The uses of funds are the following:

1. Cash loss, that is, loss before providing for all noncash expenses
2. Capital expenditure
3. Investment in other companies
4. Dividends paid
5. Redemption of term loans and repayment of other liabilities
6. Liquidation of other liability (current and noncurrent)
7. Acquisition of other assets (current and noncurrent)

The funds flow statement has two portions – one that tracks the movement of funds in the long-term account comprising noncurrent assets and noncurrent liabilities, and the other tracks the movement of funds in the short-term account, that is, amongst current assets and current liabilities. Ideally, there should be a surplus in the long-term account which is used as margin money towards working capital. A deficit in the long-term account may mean that the management has diverted short-term funds to long-term uses, which is a bad practice. Of course, it could be temporary. For instance, a company may be awaiting the proceeds of a sale of debenture or term loan. In the interim some short-term sources may be tapped to bridge the gap. A company should match long-term sources and long-term uses. For instance, capital expenditure may be financed by equity or long-term debt or some combination. Funds flow analysis throws light on major corporate financial policies like dividend policy, capital investment, and financing mix. The funds flow statement should be coupled with other techniques like ratio analysis to make meaningful judgment about the company's performance.

The prediction of business failure on the basis of financial ratios has its limitations in the sense that the choice of ratios is not based on some theory of financial failure and, hence, the model cannot be generalized.[1] Consequently, some researchers have developed cash-based funds flow model since financial value is dependent on future cash flow (Gentry et al. 1987). In other words these studies have tried to find out if the pattern of a firm's cash inflows and outflows can differentiate between financially successful and failing firms. In these models, each component of funds flow (e.g., inventory or accounts receivable) is expressed as fraction of total net flow (= inflows − outflows) to determine the percentage each component to the total. The mean and standard deviation of funds flow components of failed and nonfailed firms are compared to see if there is any pattern. The standard deviation of failed firms is usually substantially larger than nonfailed firms. These studies have found that funds flow components provide a reliable signal for discriminating between failed and nonfailed firms.

7.3 Funds Flow vs Cash Flow Statement

A funds flow statement is a broader concept than the cash flow statement in the sense that it reflects changes in all accounts including cash. A cash flow statement tries to explain the change in cash position between two balance sheet dates. Thus, an increase in plant and machinery will be recorded as a use in funds flow statement but may not be recorded in cash flow statement if it does not involve a cash outlay during the period. In short, noncash transactions do not enter the cash flow statement. The net cash flow is simply the net of all inflows and outflows during the period. The cash flow statement is helpful in a number of situations where cash flows are important. These include the following:

- Analysis of credit proposals
- Firm's need for external financing and the use of its long-term debt
- Firm's ability to meet current and long-term cash obligations
- Ability of the firm's operations to generate cash

Thus,

$$\text{Cash balance at the beginning of the year} + \text{net cash flow during the year}$$
$$= \text{cash balance at the end of the year.}$$

7.4 Why Focus on a Cash Flow Statement?

Net income reported on the income statement provides an important measure of performance. However, in the absence of cash flow, income does not pay the bills. Interest and dividend payments, required principal reductions on debt, and capital expenditures for plant and equipment and for expansion cannot be made without

[1] The Altman Z-score model for instance.

cash. Cash provided by operating activities, also known as, operating cash flow, is a primary source of cash to meet these needs. In the absence of operating cash flow, cash from other sources can be used to cover cash requirements. For example, cash can be obtained by new debt or equity issues or nonrecurring asset sales. These nonoperating cash flows can be relied upon only in the short run. In the long run, operating cash flow is the only reliable source of cash available to meet recurring needs.

Indeed, the cash flow statement provides more information than the balance sheet or the income statement. It can help unearth valuable information relating operating, investing, and financing activities of the firm.

7.5 Structure of a Cash Flow Statement

Items on the cash flow statement come from two sources: (1) income statement items and (2) changes in balance sheet accounts. It is useful to classify cash flows on the basis of activities. The standard practice for preparing the cash flow statement is to classify activities into – operating, investing, and financing activities and record cash flow under each heading.

$$\begin{gathered}\text{Cash Flow from operations} + \text{Cash flow from Investment activities}\\ + \text{Cash Flow from financing activities} + \text{Net effect of exchange rate changes on cash}\\ = \text{Net increase (decrease) in cash.}\end{gathered}$$

A pro forma cash flow statement is shown in Exhibit 7.1. A manager or an analyst can make useful interpretations like: Where is the cash coming from? How is it being used? What are the levels of and trends in cash flows from the three types of activities?

7.5.1 Cash Flow from Operating Activities

Operating activities are related to the firm's ongoing ability to generate cash from operations. This includes information on cash receipts from customers for sales and service, cash payments related to vendors, employees, taxes, and interest. The net of all these gives cash flow from operations.

Cash flow from operating activities shows the result of cash inflows and outflows due to the fundamental operations of the company, like cash receipts from sale of goods and services, payment of rent and taxes, purchase of inventory, etc. Note that cash from operating activities is arrived at in the "indirect format" in the sense that it starts with the net income figure and adjustments are made. The direct format for preparation of cash flow from operations is prepared by deducting cash outflows from cash inflows to arrive at net cash flows.

Cash flow from operating activities provides cash necessary for replacement of assets and payment of dividends. The key elements of cash flow from operations are the following:

Exhibit 7.1 Statement of cash flows

Cash flow from operating activities	
Net income	–
Adjustments to reconcile net income to net cash provided by operating activities:	
Depreciation and amortization	
Changes in other accounts affecting operations	
(Increase)/decrease in accounts receivable	
(Increase)/decrease in inventories	
(Increase)/decrease in prepaid expenses	
(Increase)/decrease in accounts payable	
(Increase)/decrease in taxes payable	
Net cash provided by operating activities	xxxx
Cash flow from investing activities	
Capital Expenditures	
Proceeds from sale of equipment	
Proceeds from sale of investments	
Investment in Subsidiary	
Net cash provided by financing activities	xxxx
Cash flow from financing activities	
Payments of long term debt	
Proceeds from issuance of long term debt	
Proceeds from issuance of common stock	
Dividends paid	
Purchase of treasury stock	
Net cash provided by (used in) financing activities	xxxx
Increase (decrease) in cash	xxxx

- Cash collections from sales
- Cash operating expenses
- Cash interest expense
- Cash tax payments

Note that interest expense is classified under operating activities though it is meant to service debt because it comes in the income statement before tax. Dividends are, however, classified under financing activities as they come after taxes.

7.5.2 Cash Flow from Operating Activities: Direct and Indirect Formats

There are two ways of arriving at the net operating cash flow: direct and indirect methods. Under the direct method all cash inflows are recorded during the period and all outflows are deducted to arrive at the net cash flow.

The net cash flow could be either positive or negative depending on whether the company has generated or consumed cash.

Consider a hypothetical company that starts with $1,000 in hand. During the period, the company pays its suppliers, workers, etc., amounting to $600. Customers pay $700 during the period.

$$\text{Net Cash Flow} = -600 + 700 = \$100,$$
$$\text{Cash balance at the end} = \$1{,}100.$$

The cash flow statement is usually prepared for the year although any other duration may be chosen. Net profit is not the same as cash flow. The financial statements are prepared on the accrual basis of accounting. For instance, sales are recorded when products are sold even if customers do not pay cash immediately or salaries are recorded as expense even when in reality the actual cash outflow is in the next period. (say, the beginning of next month). The cash flow statement is designed to analyze the underlying cash flow position. Cash flow might be higher or lower than the net profit figure. The direct method illustrated above is simple and straightforward but time consuming. Managers of the company who have intricate details of the transactions can use it. The indirect method arrives at the same result in a circuitous way. Starting with the net income figure, a series of adjustments are made to transform the net income into cash flow from operations.

Exhibit 7.2 presents the two formats of calculating cash flow from operating activities.

Many believe the direct format is better, because it is easier to understand. However, if companies choose the direct format they must also present a reconciliation between cash flows from operating activities and net income – which is what the indirect format does. Consequently, most companies follow only the indirect method.

To arrive at cash flow (from operation) from net income

Exhibit 7.2 Cash flow from operating activities: direct and indirect formats

Direct	Indirect
Cash received from customers———-xxxx	Net Income—xxxx
Cash paid to suppliers———-xxxx	Adjustments to reconcile net
Cash paid to employees———-xxxx	Income to net cash provided by operating activities
Other cash operating expenditures———-xxxx	Depreciation changes in other accounts affecting operations
Net cash provided by operating activities——xxxxx	(Increase) in receivables
	Decrease in inventory
	(Decrease) in payables
Net cash provided by operating activities	xxxx

- Add back expenses that do not involve cash outflow

For example, depreciation, amortization

- Subtract cash outflows not treated as expenses

For example, capital expenditure (machines, land, etc.)
Increase in inventory involves outflow but not recorded as expense.

- Subtract revenues that do not involve cash inflow

For example, sales on credit, that is, increase in accounts receivable
Increase in accrued interest earned.

7.5.3 Cash Flow from Investing Activities

Investment activities relate to change in noncurrent assets. This includes information on capital expenditure to acquire fixed assets and proceeds from sale of noncurrent assets. Only cash transactions get reflected. Cash flows from investing activities are cash flows associated with purchases and sales of noncurrent assets, such as building and equipment, etc. The section also contains purchase and sale of short-term investments.

Key elements in the investing activities section include the following:

- Purchases of property, plant and equipment
- Investments in joint ventures and affiliates
- Payments for businesses acquired
- Proceeds from sale of assets
- Investments (or sale of) marketable securities

7.5.4 Cash Flow from Financing Activities

Financing activities relate to changes in borrowings and owners' equity. This includes information on cash proceeds from issuing equity and short-term and long-term debt, and cash outflow due to repurchase of shares. Dividend payment is also a financing activity. Cash flows from financing activities include issuance and repayment of debt, issuance of common stock, and payment of dividends. Interest on debt, however, is clubbed under cash from operating activities. Key elements include

- Cash dividends paid
- Increases or decreases in short-term borrowings
- Long-term borrowings and repayments
- Stock sales and repurchases

Translation gains and losses resulting from exchange rate fluctuations will directly flow through to balance sheet upon translation to the reporting currency. Since, it is a noncash transaction it does not flow into any of the components of the cash flow statement. It is a reconciling item. See the cash flow statement of Colgate Palmolive given in the exercise at the end of the chapter.

7.5.5 Interpretation of the Cash Flow Statement

The cash flow pattern depends on the nature of business and the life cycle of the company. Start up companies in high growth industries will have negative cash flow because of high capital expenditure in relation to the level of earnings. The gap is to be met by selling debt or equity. Established growth companies can meet their investment requirements from internally generated funds. Mature companies will have modest capital expenditure requirements. Their cash flow from operations will be slightly more than the reinvestments. Those firms in the declining phase will have surplus cash from operations which could be returned to shareholders, pay off debt, or revitalize product lines. Turnarounds are characterized by cash inflows due to freeing up of assets and income statement losses. Thus the cash flow pattern indicates the position of a company in its business life cycle the nature of its model. To start with, cash flow from operations should be positive and growing.

Second, see whether the company is investing to grow, that is, whether investments are more than depreciation. Healthy companies typically purchase more assets than they sell. So cash flow from investing will usually be negative. To judge whether a company is doing well or not, one must use evidence from all pieces and put them together.

An analyst can prepare a checklist of major sources and uses as well as trends in cash flow from operations, net income, dividend, and working capital accounts as shown in Exhibit 7.3.

The cash flow statements of General Electric (GE) Company for the years 2003, 2004, and 2005 are given in Exhibit 7.4. The GE Company is a diversified industrial company that has business interests ranging from jet engines to power generation, financial services to plastics, and medical imaging to news and information.

The first step in the analysis is to place the company in the context of its size, age, and industry. Large, mature companies like GE would have substantial free cash flow compared to small firms. Further, large firms can also experience large declines in free cash flow (e.g., General Motors in the recent years) but can usually withstand one time declines because of their accumulated cash flow. Small firms, in contrast, would be unable to withstand declines in cash flows because of lack of resources.

GE generated about \$16.7 billion in net income and \$37.6 billion from cash flow from operations in 2005, substantial by any standard. We apply the aforementioned checklist to GE for 2005 (Exhibit 7.5).

Exhibit 7.3 Checklist of major sources and uses of cash

	Year t	Year t-1	Year t-2
Major source	Loan proceeds Revenue inflow Decrease in working Capital	Decrease in W.C Non op. Income Loan Bonds/Equity	Dec. in W.C Revenue inflow Loan/Bonds
Major uses	Purchase of fixed assets Interest	Purchase of F.A Interest Repayment of loans	Purchase of F.A Interest Repayment of loans
CFO >NI	Yes/No	Yes/No	Yes/No
Trends in			
Income	Increase/decrease in profit/loss	Increase/decrease in profit/loss	Increase/decrease in profit/loss
CFO	Up/down	Up/down	Up/down
Dividends	Yes/no	Yes/no	Yes/no
Net borrowing	Borrowed/repaid	Borrowed/repaid	Borrowed/repaid
Working capital	Increasing/ decreasing	Increasing/ decreasing	Increasing/ decreasing

Exhibit 7.4 Cash flow statements of General Electric (*GE*) Company (in $million)

	2005	2004	2003
Cash flows-operating activities			
Net Earnings	16,711	17,160	15,561
Loss (earnings) from discontinued operations	1,922	(534)	(2,057)
Cumulative effect of accounting changes	–	–	–
Adjustments to reconcile net earnings to cash provided from operating activities			
Depreciation and amortization	8,538	8,349	6,864
Earnings before accounting changes retained by GECS	–	–	–
Deferred income taxes	(890)	50	1,417
Decrease (increase) in GE current receivables	(360)	(849)	534
Decrease (increase) in inventories	(578)	(468)	874
Increase in accounts payable	1,238	4,090	232
Inc (Dec) in GE progress collections	510	(464)	(2,268)

(continued)

Exhibit 7.4 (continued)

	2005	2004	2003
Inc (Dec) in insurance liabilities	1,034	1,959	(729)
Provisions on losses on GECS financing receivables	3,841	3,888	3,752
All other operating activities	1,821	(2,699)	(2,927)
Cash from operating activities-continuing Operations	33,787	30,482	21,840
Cash from operating activities-discontinued Operations	3,854	6,002	7,389
Cash from operating activities	37,641	36,484	29,229
Cash flows-investing activities			
Additions to PP&E	(14,441)	(13,092)	(9,751)
Dispositions of PP&E	6,027	5,838	4,918
Net increase in GECS financing receivables	(16,954)	(15,280)	(4,687)
Payments for principal businesses purchased	(11,498)	(18,703)	(14,352)
All other investing activities	6,535	10,785	7,974
Cash used for investing activities-continued op	(30,331)	(30,452)	(15,898)
Cash used for investing activities-discontinued op	(4,718)	(7,962)	(5,945)
Cash used for investing activities	(35,049)	(38,414)	(21,843)
Net increase (decrease) in borrowings (maturities $<$ 90 days)	(4,600)	(1,558)	(20,559)
Newly issued debt (maturities $>$ 90 days)	66,523	58,538	67,719
Repayments and other reductions (maturities $>$ 90 days)	(53,133)	(47,106)	(43,479)
Net dispositions (purchases) of GE treasury shares	(4,844)	3,993	726
Dividends paid to shareowners	(9,352)	(8,278)	(7,643)

(continued)

Exhibit 7.4 (continued)

	2005	2004	2003
All other financing activities	(1,191)	(3,397)	286
Cash from (used for) financing activities-continuing Operations	(6,597)	2192	(2,950)
Cash from (used for) financing activities-Discontinued operations	478	2,402	(682)
Cash from (used for) financing activities	(6,119)	4,594	(3,632)
Increase (decrease) in cash and equivalents during the year	(3,527)	2,664	3,754
Cash and equivalents at beginning of the year	15,328	12,664	8,910
Less cash and equivalents of discontinued			
Operations at end of year	2,790	3,176	2,734
Cash and equivalents of continuing operations at end of year	9,011	12,152	9,930
Supplemental disclosure of cash flow information			
Cash paid during the year for interest	(16,446)	(11,907)	(10,910)
Cash recovered (paid) during the year for income taxes	(3,254)	(1,339)	(1,539)

GE's cash flow is strong and growing. It has invested heavily in new businesses and Property, Plant, and Equipment (PP&E). It is a net borrower. Its working capital position is comfortable. It pays dividends. From "We Bring Good Things to Life" to "Progress is Our Most Important Product" and "Live Better Electrically," GE has a rich tradition of campaigns built on the theme of progress. It has a tradition of "imagination at work." GE was founded by Thomas Edison in 1878. Since then the company has a rich tradition of producing great business leaders like John F Welch. GE was named number one in fortune Magazine's annual list of most admired companies in 2006 and 2007. GE's much-publicized "Ecomagination" campaign is aimed at supercharging revenues while doubling its $700 million R&D budget to come up with solar-energy hybrid locomotives, lower-emission aircraft engines, more efficient lighting, and ever more sophisticated water-purification systems. Of the 12 companies Charles Dow chose to make up his original Dow Jones Industrial Average in 1896, GE is the only one still in the index.

Exhibit 7.5 Analysis of General Electric's (GE's) cash flow statement

	Year 2005	Year 2004	Year 2003
Major source	(1) Newly issued debt (2) Net Income (3) Earnings from discontinued Operations (4) Depreciation/amortization (5) Dispositions of PP&E		
Major uses	(1) Repayment of debt (2) Dividends (3) Additions to PP&E (4) Payments for principal businesses purchased		
CFO >NI	Yes	Yes	Yes
Reasons	(1) Depreciation (2) Earnings from discontinued operations (3) Increase in accounts payable		
Trends in			
Income	Decrease in profit	Increase in profit	Profit
CFO	Up	Up substantially	Large
Dividends	Yes	Yes	Yes
Net borrowing	Net borrower	Net borrower	Net borrower
Working capital	–	–	–

7.6 Information Content and Abuse of Cash Flow Statements

As pointed out earlier, if companies choose the direct format they must also present reconciliation between cash flows from operating activities and net income – which is what the indirect format does. Consequently, most companies follow only the indirect method. Studies have shown that analysts and other users prefer the direct method for reports of operating cash flows. The direct method shows major categories of cash inflows and outflows whereas the indirect method only reconciles net income and operating cash flow. Further, the indirect method is hard to understand for an unsophisticated reader. Both methods, however, have their advantages and disadvantages.

Companies can often manipulate the cash flow statement to report high cash flow from operations so that the stock market uses the higher free cash flow to place a higher value on the company's stock.

Tyco, for example, engaged in transactions for its security alarm business to purchase customer contracts from dealers totaling more than $800 million. The cash paid for these contracts was reported as a cash outflow in the *investing* activities section of the statement of cash flows. When the customers made payments to Tyco under these contracts, however, Tyco reported the cash received in the *operating* cash flow section. Thus, all of the cash received from the contracts increased operating cash flow whereas Tyco, had in effect, paid out cash for this stream of inflows.

That is, companies misclassify cash flows among the three sections of the statement of cash flows although the bottom line is unaffected. Using the direct method in addition to the indirect method would reduce incidences of such abuse. If both methods have information content why must companies choose one method over the other? So there are some who argue that *both* methods be used (Broome 2004).

7.7 Concluding Comments

A cash flow statement summarizes the sources and uses of cash. Operating cash flows are needed for the long-term survival of the corporation. In the initial stages of a firm's life financing cash flows are positive and investing cash flows are negative. One can infer a firm's prospects from a firm's investing activities, that is, high investments suggest management anticipates growth.

7.8 End of Chapter Exercises

1. What is the difference between funds flow statement and cash flow statement?
2. What are the three main sections of a cash flow statement and what information is presented in them?
3. What are the differences between direct and indirect methods of preparation of cash flows from operating activities?
4. Explain the limitations of cash flow statements.
5. The cash flow statements of Colgate Palmolive and Google are given in Exhibit 7.6. Rank them on a 5-point scale with 1 being worst position and 5 being the best. Compare and contrast their relative position. In particular, comment on why and how their cash flow statements differ.
6. Given below are a set of transactions. Prepare a cash flow statement.

   - Promoter contributes \$10,000 to start the business
   - Company borrows \$3,000 from the bank
   - Company purchases equipment for \$5,000 cash
   - Company performs service for \$12,000. The customer pays \$8,000 in cash and promises to pay the balance at a later date
   - Company pays \$9,000 for cash expenses (wages, interest, and maintenance)
   - Company pays dividend of \$1,000

Exhibit 7.6 Cash flow statements of Google and Colgate Palmolive

In millions of (except for per share items)	12 months Ending 2007-12-31	12 months Ending 2006-12-31	12 months Ending 2005-12-31	12 months Ending 2004-12-31	12 months Ending 2003-12-31	12 months Ending 2002-12-31
Net income/Starting Line	4,203.72	3,077.45	1,465.40	399.12	105.65	99.66
Depreciation/Depletion	807.74	494.43	256.81	128.52	43.85	17.82
Amortization	159.91	77.51	37.00	19.95	6.33	0.21
Deferred Taxes	−164.21	–	–	–	0.02	−9.87
Non-Cash Items	489.44	−112.83	656.47	682.66	245.84	32.59
Changes in Working Capital	278.80	43.95	43.74	−253.21	−6.25	14.86
Cash from Operating Activities	5,775.41	3,580.51	2,459.42	977.04	395.45	155.26
Capital Expenditures	−2,402.84	−1,902.8	−853.04	−355.90	−176.80	−37.20
Other Investing Cash Flow Items, Total	−1,278.75	−4,996.35	−2,505.16	−1,545.45	−137.15	−72.52
Cash from investing activities	−3,681.59	−6,899.15	−3,358.19	−1,901.36	−313.95	−109.72
Financing cash flow items	379.21	581.73	0.00	4.30	0.00	0.00
Total cash dividends paid	–	–	–	–	–	–
Issuance (retirement) of stock, Net	23.86	2,384.67	4,372.26	1,195.03	15.48	2.26
Issuance (retirement) of debt, Net	0.00	0.00	−1.43	−4.71	−7.39	−7.74
Cash from financing activities	403.07	2,966.40	4,370.83	1,194.62	8.09	−5.47
Foreign Exchange Effects	40.03	19.74	−21.76	7.57	1.66	0.00
Net change in cash	2,536.92	−332.50	3,450.30	277.88	91.24	40.08
Cash Interest Paid, Supplemental	1.34	0.26	0.22	0.71	1.74	2.29
Cash Taxes Paid, Supplemental	882.69	537.70	153.63	183.78	247.42	73.76

(continued)

Exhibit 7.6 (continued)

Colgate Palmolive

In millions of (except for per share items)	3 Months ending 2008-03-31	3 Months ending 2007-12-31	3 Months ending 2007-09-30	3 Months ending 2007-06-30	3 Months ending 2007-03-31
Net income/starting line	466.50	414.90	420.10	415.80	486.60
Depreciation/depletion	88.60	87.50	85.30	80.10	81.00
Amortization	–	–	–	–	–
Deferred taxes	24.00	−87.20	19.40	14.90	−94.50
Non-cash items	17.50	42.10	44.90	1.80	−5.80
Changes in working capital	−26.70	107.70	170.00	−101.50	20.60
Cash from operating activities	569.90	565.00	739.70	411.10	487.90
Capital expenditures	−85.30	−256.00	−127.50	−106.90	−92.70
Other investing cash Flow items, total	21.40	31.30	−44.90	−4.80	73.20
Cash from investing activities	−63.90	−224.70	−172.40	−111.70	−19.50
Financing cash flow items	–	–	–	–	–
Total cash dividends paid	−185.60	−199.20	−186.20	−197.40	−166.80
Issuance (retirement) of stock, net	−228.10	−227.20	−135.90	−161.40	−255.60
Issuance (retirement) of debt, net	114.20	−119.20	−169.90	125.80	−61.40
Cash from financing activities	−299.50	−545.60	−492.00	−233.00	−483.80
Foreign exchange effects	6.90	5.60	6.20	6.10	0.30
Net change in cash	213.40	−199.70	81.50	72.50	−15.10
Cash interest paid, supplemental	–	–	–	–	–
Cash taxes paid, supplemental	109.20	177.20	157.30	217.10	94.90

References

Broome W (2004) Statement of cash flows: time for change! Financ Anal J
Gentry J, Newbold P, Whitford D (1987) Fund flow components, financial ratios and bankruptcy. J Business Finance Account 14(4)

Chapter 8
Prospective Analysis: Guidelines for Forecasting Financial Statements

Ignacio Vélez-Pareja and Joseph Tham

8.1 Chapter Introduction and Objectives

Having performed an accounting and financial analysis, an analyst has to forecast financial statements into the future. This is a precursor to valuation. Many methods of forecasting like percent sales method are available. In this chapter, we provide a comprehensive overview of prospective analysis. Although parts of the chapter are written from the perspective of a company's manager, they are still valid for an analyst. After all, the analyst's perspective mirrors that of the manager.

This chapter has the following objectives:

- Highlight what data are required for forecasting
- Discuss elements of forecasting balance sheet and income statement
- Discuss the derivation of cash flows from the forecast
- Highlight implementation issues in a real-life setting

8.2 Introduction

In this chapter, we discuss some ideas that might be useful in forecasting financial statements based on historical data.[1]

The approaches and suggestions presented in this chapter assume that the analyst has access to some company information that is not usually found in publicly available financial statements.

I. Vélez-Pareja
Universidad Tecnologica de Bolivar, School of Finance and International Business, Ave. Miramar #18-93 Apto 6 A, Manga, Cartagena, Colombia

[1] Many ideas presented in this chapter are the result of advising undergraduate and graduate students in the course cash flow valuation (CFV): A basic introduction to an integrated market-based approach at Duke University during the Fall of 2005 and my experience in teaching the subject at Universidad Tecnológica de Bolívar in Cartagena, Politécnico Grancolombiano in Bogotá, and other universities in Colombia.

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_8,

In forecasting financial statements, we start with the historical financial statements and from them we identify the patterns and relationships of different items, the implicit policies, growth rates, and so on. The usual practice is to examine historical financial statements to derive information from them that can be used to forecast financial statements. As all information needed cannot be obtained from historical statements, we assume that the information is available from the company's management. We show how we can find information not found in the statements. Finally, we develop a detailed example of a hypothetical firm to explain the procedure to forecast financial statements. We also critically examine the usual practice of using plugs in forecasting financial statements.

The chapter is organized as follows: first, we present comments in a general form about the relevance of prospective analysis to nontraded firms. Specifically, we highlight the importance for these firms of having a financial model with which they can assess the value creation in the firm.

In the second section, we review concepts in accounting and economics that are used in forecasting financial statements. We stress upon a financial statement that shows the detailed inflows and outflows of cash in the firm: the cash budget (CB). This is an important tool for managing a firm. We also review topics like Pareto law and Fisher equation. Fisher equation is the key to forecasting variables linked to inflation rate. We also review the indexes used to measure inflation. The chapter uses the Fisher equation to forecast interest rates and increases in prices.

Special mention is devoted to a usual practice when forecasting: the plug. This is a practice that we do not recommend and show an alternate approach. The approach we propose in this chapter follows an accounting principle that is the basis of any accounting procedure: the Double Entry Principle. This principle guarantees consistent and error-free financial statements. We show with a simple example how the plug works and its limitations.

Next, the reader will find what information is needed for forecasting financial statements and where and how to find it. We identify the procedure to identify policies that govern the working of a firm such as accounts receivable and payable (AR and AP), inventories, dividend payout, payments in advance, and the like. We also deal with the real-life problem of a firm with multiple products and/or services.

Finally, we show some tools to perform sensitivity analysis for financial management and analysis. We also use this tool to check the consistency of the financial model.

In the next two sections, we deal with the relevance of several accounting concepts. In particular, we briefly describe the CB.

8.3 General Comment on Financial Statement Forecasting

Forecasting financial statements is imperative for the management because it can provide a rough guide to the future performance of the firm. It is very important to do some prospective analysis for the long-term (LT) to develop strategies for meeting the challenges that may arise. Moreover, for most firms, it is vital to have a financial model that allows management to control value creation. This can be done by constructing cash flows from the financial statements and estimating the firm value. We propose to construct three financial statements: balance sheet (BS), income statement (IS), and CB without plugs and without circularity.[2]

Much of the economic activity in the world takes place inside nontraded firms. Even in a developed country like the United States, traded firms account for less than 0.5% of the total firms. In emerging markets the proportion is much less.

The financial model would be useful to examine and anticipate the economic effect of a decision. This can be done through the use of sensitivity analysis, scenario analysis, and Monte Carlo simulation. In addition, the financial model can be used to time capital market issues or in planning capital expenditure.

8.3.1 The Cash Budget

The cash budget (CB) or cash forecast (other names are cash flow or fund flow) shows the liquidity of the firm. In other words, the CB shows the amount of cash available at each point in time. In the CB, we record all the inflows and outflows of the firm. We can think of the CB as a financial statement that records all the checkbook transactions in the firm. The CB shows all the cash transactions of the firm. It shows how much cash goes into the firm bank account and how much cash goes out. The cumulative cash remaining is what the firm has as cash in hand at the end of any period. It should be identical to the amount of cash that is listed in the BS. Moreover, the CB is very powerful tool for the financial management of any firm.

Perhaps the CB is the most important financial statement in the firm for financial management purposes. With it we can estimate the financing needs and the cash surplus in each period. Some typical items in the CB statement are shown in the Table 8.1.

The CB can help us answer questions such as when do we need funds? How much money do we need? Can we obtain it by speeding up the repayment of sales sold to customers? Is there a limit in the amount of sales? Can we postpone some payments? Can we renegotiate the debt terms with the bank? Can we increase sales with the available resources? For how long can we increase the sales with the actual available resources? If we increase sales, how much funds do we need to support the increase? How can we negotiate a debt schedule profile with the bank? Which is the maximum debt capacity of the firm in a given planning horizon? When and how much liquidity will we have?

For convenience, we can organize the CB in modules according to the type of transactions we record. The CB we present is similar, in some way, to the cash flow statement according to generally accepted accounting principles. However, the CB is more detailed and of course is prospective, not an ex-post analysis.

---

[2] The uselessness and distractions of plugs and circularity will be apparent later in the chapter.

Table 8.1 Typical items in the cash budget statement

Inflows	Outflows
Sales on cash	Accounts payable payments for purchases
Accounts receivables recovery	Salaries and fringe benefits
Loans received	Interest payments
Equity invested	Principal payments
Repayments of loans lent to third parties	Rent
Interest received from loans to third parties	Overhead expenses
Sale of inventories	Promotion and advertising
Sale of fixed assets	Asset acquisition
Sale of other assets	Social security payments
Interest on marketable securities	Earnings distributed or dividends paid
Redemption of marketable securities	Taxes paid (income, capital gains, VAT)
Customers' in advance payments	Investment in marketable securities
Value added tax (VAT) collected	Repurchase of equity
	Loans lent to third parties

Taken and adapted from Tham and Vélez-Pareja (2004)

This approach is integral and allows the management to conduct sensitivity analysis from the input data. When we say integral we mean that everything in the model is linked to some input data (input variables) in such a way that a change in one of them will give a specific result.

8.3.2 Detailed Description of the CB

It is convenient to organize the CB in five modules as follows:

1. Module 1: operating activities
   1.1. Operating inflows (sales) and advance payments from customers
   1.2. Operating outflows (raw material, labor costs, taxes, overhead expenses, sales expenses, etc.)
   1.3. Net cash balance (NCB) before investment in fixed assets
2. Module 2: investment in fixed assets
   2.1. Initial investment in assets
   2.2. Investment in assets in other periods
   2.3. NCB of purchasing assets
   2.4. NCB after investing in fixed assets.[3]
3. Module 3: external financing
   3.1. Inflow of loans in local or foreign currency (converted to local currency)
   3.2. Principal payment of loans (local or foreign currency)

[3] With this NCB, we could estimate the debt capacity of the firm. If we discount this NCB with the expected cost of debt, we will have the maximum amount the firm can repay during the forecast horizon.

3.3. Interest paid for local or foreign currency loans
3.4. NCB of financing

4. Module 4: transactions with owners

4.1. Equity investment
4.2. Dividends payment
4.3. Repurchase of equity.
4.4. NCB of transactions with owners
4.5. NCB for the year after previous transactions

5. Module 5: discretionary transactions

5.1. Inflow from sale of marketable securities
5.2. Interest from marketable securities
5.3. Investment in marketable securities
5.4. NCB of discretionary transactions
5.5. NCB for the period
5.6. Cumulated cash balance

The reason for the above organization of the CB is related to the calculation of debt and short-term (ST) investments and to the construction of cash flows for valuing the firm using the direct method.

8.4 Review of Economics

8.4.1 Pareto Law

The Pareto[4] law suggests that a majority of the result (about 80%) is due to the contribution of a minority (about 20%). In a firm, for instance, 80% of revenues could be generated by 20% of the customers, or 80% of revenues could be generated by 20% of the products.

8.4.2 Fisher Equation

The Fischer equation suggests that

$$1 + \text{nominal change} = (1 + \text{real change}) \times (1 + \text{inflation}). \tag{8.1a}$$

[4] Who was Pareto? "Vilfredo Federico Damaso Pareto ([...] July 15, 1848, Paris – August 19, 1923, Geneva) was an Italian sociologist, economist, and philosopher. He made several important contributions especially in the study of income distribution and in the analysis of individuals' choices. He introduced the concept of Pareto efficiency and helped develop the field of Pareto efficiency." From http://en.wikipedia.org/wiki/Vilfredo_Pareto visited on April 28, 2008.

We can rewrite it as

$$1 + \text{real change} = \frac{1 + \text{nominal change}}{1 + \text{inflation}}. \tag{8.1b}$$

From (8.1b), we have

$$\text{Real change} = \frac{1 + \text{nominal change}}{1 + \text{inflation}} - 1. \tag{8.1c}$$

8.4.3 Nominal and Real Gross Domestic Product

Gross domestic product (GDP) is the market value of goods and services produced by a country. GDP is measured by adding consumption, investment, government purchases, and net exports.

The GDP can be measured with or without the effect of inflation. In the first case it is the nominal or current dollar GDP; the second case is the real or constant dollar GDP. The nominal GDP is measured by valuing each item at the actual market price. The constant price GDP is valued with respect to the prices of a base year (or reference year).

8.4.4 Inflation Rate

Inflation is a measure for the general increase in prices in an economy. There are three indexes that measure the inflation: the consumer price index (CPI) the producer price index (PPI) and the implicit deflator of the GDP.

8.4.4.1 Consumer Price Index

A price index is a tool that simplifies the measurement of price movements in a numerical series. Movements are measured with respect to the base period, when the index is set to 100.

(Consumer price index)or cost-of-living index: A cost-of-living index measures differences in the price of goods and services, and allows for substitutions to other items as prices change. A CPI measures a price change for a constant market basket of goods and services from one period to the next within the same city (or in the Nation). The CPIs are not true cost-of-living indexes and should not be used for place-to-place comparisons.[5] The CPI is measured using a basket of goods consumed by a typical household. Inflation is a measure of the increase in prices

[5] US Department of Labor, http://www.bls.gov/bls/glossary.htm#P, visited on April 28, 2008.

in an economy. The CPI includes all the goods and services consumed by the population, including those goods not produced in the country but imported from abroad.

8.4.4.2 Producer Price Index

The producer price index (PPI) program measures the average change over time in the selling prices received by domestic producers for their output. The prices included in the PPI are from the first commercial transaction for many products and some services.[6]

PPI: A family of indexes that measure the average change over time in selling prices received by domestic producers of goods and services. PPIs measure price change from the perspective of the seller. This contrasts with other measures that measure price change from the purchaser's perspective, such as the CPI. Sellers' and purchasers' prices may differ due to government subsidies, sales and excise taxes, and distribution costs.[7] As can be observed, the PPI measures the price of a good or service produced or not in the country, but when it is sold for the first time; this means that it is not related to the price the end user pays.

8.4.4.3 GDP Implicit Price Deflator

The standard definition of this deflator is "Current dollar GDP divided by constant dollar GDP. This ratio is used to account for the effects of inflation, by reflecting the change in the prices of the bundle of goods that make up the GDP as well as the changes to the bundle itself."[8] This index includes only the goods and services produced in the country; it does not include imported goods or services.

$$\text{GDP deflator} = \frac{\text{Nominal GDP}}{\text{Real GDP}} \times 100. \tag{8.2}$$

8.5 Review of Current Practices in Forecasting Financial Statements

8.5.1 Definition and Use of Plugs

The current practice in forecasting involves oversimplification. These methods might have been valid more than 40 years ago, when computing resources were scarce. For instance, when forecasting financial statements the common practice

[6] US Department of Labor, http://www.bls.gov/ppi/, visited on April 28, 2008.

[7] US Department of Labor, http://www.bls.gov/bls/glossary.htm#P, visited on April 28, 2008.

[8] See http://www.investopedia.com/terms/g/gdppricedeflator.asp, visited on April 28, 2008.

is to forecast sales revenues and calculate the previous financial statements as a percentage of sales revenues and apply those percentages to the forecasted sales revenues and from that the BS and the IS are derived. This is not the most appropriate approach as it involves use of plugs and/or circularity (iterations).

Kester (1987) illustrates the use of computationally efficient algebraic formulas that directly solve the balancing problem that occurs in financial forecasting when projected assets do not equal projected liabilities and equity. Specifically, the formulas can be used to compute funds deficits/excesses that adjust for the simultaneous effects on income taxes and dividends and hence should be valuable for both classroom and practical use. The approach proposed by Kester needs iterations to solve circularity. Arnold and Peter (2007) propose a solution for the circularity problem when using plugs. Their solution consists in determining the value of the current debt using variables such as earnings before interest and taxes (EBIT), equity, retained earnings, tax rate, dividends payout ratio, and cost of debt. However, they use plugs.

A plug is a formula to match the BS using differences in some items listed in it in such a way that the accounting equation holds. In other words, a plug is an item which guarantees that assets = [total] liabilities + equity. Plug is usually a financing item such as cash, debt, or common stock [...]. The plug is not a number. It is an equation, for instance,

Cash = total liabilities [+ equity] – [noncash] current assets – net fixed assets,
Debt = total assets – current liabilities – equity,
Equity = total assets – current liabilities – debt.

8.5.2 Advantages and Disadvantages of Using Plugs

This is easy to implement but could be erroneous. Certain numbers in the financial statements could be in error and still the plug would indicate that everything is correct because the BS matches. Using plugs presents a problem for the forecasting of financial statements: the analyst could make a lot of mistakes and the method does not help identify these mistakes because it always shows that the BS is balanced or matched. This means that one of the main advantages of the double-entry accounting is lost. In Appendix D, the reader will find examples of problems of using plugs.

A common practice is to calculate interest charges and/or return based on the average of beginning and ending balance of debt (investment). This might have been appropriate when we did not have the calculating resources of today. With spreadsheets, we can use up to 256 columns and 65,536 lines. If we use a column for a month, we could cover more than 21 years of analysis. If that is not good enough, we could work with quarters or bimesters (periods of 2 months)[9] and cover more than

[9] Bimester is not included in the Merriam-Webster Dictionary, but its definition can be found in http://onlinedictionary.datasegment.com/word/bimester, http://www.thefreedictionary.

60 years or 42 years, respectively. In other words, using average of debt to calculate interest is not necessary because we could construct the model for a convenient and practical length of time: month, quarters, semesters, and so on. When using average debt, we need to activate the iteration ability of a spreadsheet. Otherwise circularity will appear. There are some instances in corporate finance where circularity is unavoidable (e.g., estimation of weighted average cost of capital, WACC). However, in constructing pro forma financial statements circularity is avoidable.[10]

8.6 What Information Do We Need for Forecasting?

To construct and forecast cash flows from a set of financial statement, we need a lot of information. However, much of the information can be derived from historical financial statements. Other information has to be found outside the firm or have to be requested from the firm to prepare a reliable forecast. In addition to the information from the financial statements, we need some extra information, such as

- Debt schedule of actual debt
- Quantities of all goods and/or services sold
- Historical prices of goods and/or services
- Historical prices of inputs
- Product mix
- Depreciation method
- Demand driver
- Schedule of capital expenditure

8.6.1 What Information is Not in the Financial Statement?

Not all the information needed for the forecast is in the financial statements. We either need exogenous information such as inflation rates or endogenous information such as quantities sold and prices.

Usually in the financial statements, the analyst does not find explicit information on quantities sold, quantities purchased, number of products, and their share in revenues and expenses, historical prices of inputs, outputs, and specific expenses. In addition, there are exogenous data that have to be found elsewhere, such as inflation

com/bimester, http://www.diracdelta.co.uk/science/source/b/i/bimester/source.html, http://www.audioenglish.net/dictionary/bimester.htm, http://www.webdictionary.co.uk/definition.php?query = bimester.

[10] We have to say, for the record, that using the adjusted present value (APV) or valuing the capital cash flow (CCF) when we assume that the discount rate for the tax shield or tax savings is the cost of unlevered equity (Ku), we can calculate the value of the firm without circularity.

rates and specifically, CPI, PPI, or GDP implicit price deflator. The analysis of these two variables will provide information on real increase in prices and the increase in volume.

The actual debt schedule is a critical part of the financial statements. If there is no information on the repayment schedule of some liabilities in the historical financial statements, assume a reasonable period to pay back the debt based on the last interest rate calculated using historical financial statements. Construct the debt schedule for each loan. It is usually possible to get the information actual debt repayment schedule from the firm.

We need to know the depreciation method the firm uses and the remaining useful life for each type of assets. Different assets have different depreciation lives. For instance, land is not subject to depreciation, buildings have 20 years, vehicles and plant equipment 10 years, and vehicles 5 years. This might be a huge task and probably it will be necessary to make some simplifying assumptions. When forecasting financial statements it might be necessary to simplify and assume a weighted average or even assume that the total amount of assets is depreciated at a given typical life.

The demand for a firm's products depends on the growth rate in the target market. Compare the estimated growth with the growth rates found in the historical financial statements and assess if they are consistent.

8.6.2 What Information is in or can be Derived from Historical Statements?

In estimating some variables, it is customary to examine past averages. When it is advisable to use averages as an indicator or measure of a given variable or policy? For instance, when we examine the AR policy, we divide the AR by sales revenues. In doing so, we implicitly eliminate any distortion induced by other variables like inflation or currency. This ratio is calculated for previous years and assumed to hold good in future. Another example of proper use of the average is when we estimate the real increase in a price. The real increase in price results after we have deflated the nominal increase. A final example is when we estimate the risk premium of an interest rate. In short, use averages when you have proportions or real changes in a variable.

Some inputs are not variables but policies or goals: policies such as AR, inventory, AP, payout ratio, and cash in hand. For instance, the management has control on AR policy, price increase, final inventory policy, and the like. These can be estimated from historical financial statements. For the analyses in the base case scenario, we can assume that the future policies will be similar to the policies in the past. If subsequent sensitivity and Monte Carlo analysis is done, we can examine the impacts of changes in the policies on the cash flows from the different points of view.

We can estimate an AR policy examining the historical financial statement and calculating the proportion of AR to sales of the same year. Average this number and use it as the policy for the forecast years. The same can be done with AP, cash, payout ratio, and inventory policy. In the case of AP, we find them as a percentage of purchases and inventory as a percentage of cost of goods sold (COGS).

Cost of debt can be derived from the financial statements. Look at the historical interest rates: cost of debt and returns on marketable securities.

The interest rate on debt is composed of the expected inflation rate, the real rate of interest, and a component that takes into account default risk. The higher the risk, the higher is the interest rate. The risk component is known as debt risk premium. It depends on the risk perceived by the lender. If this information is not available within the firm we can make a rough estimate of the risk premium using capital market data. To estimate the risk premium subtract the risk-free rate from the borrowing rate. In this case, use the average of that difference over the last 10–20 years.

In the same way, we can examine the return on ST investment. The return on ST investments is usually lower than other investments. One of the reasons is that by definition that investment can be redeemed any moment. This fact lowers the return. The ST return can be estimated by dividing the interest income with the ST investment in the previous period. Hence, the risk premium for the return on marketable securities can be calculated subtracting the risk-free rate and average the result.

We can analyze historical expenses to detect their behavior. It is inappropriate to calculate expenses as a percent of revenues, especially those expenditures that by their nature seem to be fixed costs. Fixed costs do not increase (within some limits) with the level of activity of the firm; examples are staff salaries, rent, and depreciation of fixed assets. It is better to look at the historical behavior by deflating them and trying to estimate the real growth with the deflated figures. The inflation effect could be introduced while preparing the forecast.

Selling costs are calculated using promotional plans, manpower schedules, advertising commitments, and so on. General and administrative expenses can be calculated as % of sales or forecasted in absolute amounts using budgets.

If depreciation is not disaggregated in the historical financial statements and the investment in fixed assets is calculated as the difference between net fixed assets from one period to the next, or as the difference between book value of assets, there might be a wrong estimation of the capital investment during the historical period. The correct way to estimate capital investment expenditures in a year t is to calculate it as

$$\text{Investment}_t = (\text{Net fixed assets})_t - (\text{Net fixed assets})_{t-1} + \text{Depreciation}_t. \quad (8.3)$$

Another approach to roughly estimate depreciation charges from historical financial statements is to find the difference between earnings before interest, taxes, depreciation and amortization (EBITDA) and EBIT. This difference is an upper limit for depreciation charges (it might have amortization charges in it). This information is usually available for traded firms. If historical depreciation charges are not identified, it might be necessary to define a method of depreciation and depart from the last figure for net assets in the latest historical BS. Be careful not to depreciate an asset beyond its actual book net value.

Table 8.2 Depreciation schedule with "reinvestment" of the depreciation

Year	0	1	2	3	4	5
Real growth rate, g		1.00%	1.00%	2.00%	2.00%	2.00%
Beginning net fixed assets		400.0	404.0	408.0	416.2	424.5
Annual depreciation (5 years)		80.0	96.8	117.0	142.0	172.1
Cumulated depreciation		80.0	176.8	293.8	435.8	607.8
Investment in new assets$_t$ = depreciation$_t$ + real g in units × net assets$_{t-1}$	400.0	84.0	100.8	125.1	150.3	180.5
Net fixed assets	400.0	404.0	408.0	416.2	424.5	433.0

Although capital investment expenditures do not occur as a function of revenues, they can be expressed as the historical average expense as a percent of revenues. It might be better to calculate that percent in terms of deflated or real revenues and adjust for the future domestic or foreign inflation rate. Another alternative to forecast capital investment expenditures is to invest the depreciation charge of the period plus the rate of real growth of the revenues (growth of units sold) times the net fixed assets for the previous period. In this chapter, we assume the investment if operating assets is identical to the depreciation of the period.

We need to keep track of the "new" investment to adjust the depreciation charge. Table 8.2 presents an example.

In this table, we assume a depreciation life of 5 years. For example, investment in new assets in year 2 is $96.8 + 1\% \times 404 = 96.8 + 4.04 = 100.84$. On the contrary, depreciation for year 3 is $96.8 + 100.8/5 = 96.8 + 20.16 = 116.96$. Care has to be taken to keep track of new investment and include the new depreciation charge. Observe that depreciation for year 2 has increased to 116.96 because we have added the extra depreciation charge of 20.16.

You might be tempted to express all the lines in the financial statements as a percent of revenues. For instance, taxes should not be calculated as a percentage of revenues but as a percentage of earnings before tax (EBT). To estimate the average tax rate, sum all the taxes and divide by the sum of all the EBTs. This will give you a weighted average of the tax rate. This weighted average can be used as the tax rate for forecasted financial statements.

8.7 How Long Should the Forecast be?

It is difficult to generalize. The usual practice is to forecast for 7–10 years.

Not only is it necessary to define the time span of the forecast but also to define the time period. In a previous section, we commented on the possibility and advantages of using monthly periods. Apart from avoiding an unnecessary circularity, it is important to recognize business cycles and seasonality that affect the particular firm. For instance, firms with extreme business or economic cycles should cover at least two cycles. For instance, the construction industry usually has long economic cycles. Firms with strong monthly seasonality (e.g., toys or clothes) should consider using months instead of years.

Another issue regarding the length of the forecast has to do with the use of the forecast itself. We have said that the financial model should be a tool for value-based management. This means that forecasts have to be permanently updated and should include a continuing or terminal value. Terminal value captures all the value creation beyond the forecasting period. The usual procedure to calculate the terminal value is to assume that the firm would grow at a constant rate or does not grow in real terms forever. The influence of terminal value in the firm value will be higher for ST forecast and lower for LT forecast. This influence has to do with the discounting of that terminal value and hence, the farther the terminal value is, the lesser is its impact on the total value.

8.8 Dealing with Multiple Products and/or Services

Firms often sell more than one product. Forecasting revenues and expenses for a multi product company is more complicated than that for a single product company.

If disaggregate information exists, then use Pareto's law: 20% of the causes are responsible of 80% of the effects. This can be useful if it is necessary to reduce the number of inputs and/or products in a complex firm like Wal-Mart or K-Mart.

In some instances, it might be useful and possible to reduce an apparently large number of products to only one. This happens in firms with a common input in all products. Examples include tire manufacturers, educational institutions, and alcohol companies. All these firms might be considered as selling a sole product: tons of rubber or tons of paper or gallons of beer. This insight might make it easier to forecast the number of units sold and there might not be any need to start from dollar amounts from the historical financial statements.

Sometimes the product or service cannot be defined in a precise manner because it depends on the needs of the customer. Imagine a consulting firm or an air conditioning maintenance firm. The services they provide depend on customer's needs and preferences. In such cases it might be better to assume that the product the firm sells is time. So, what they sell is specialized man hours. If it is not possible to identify the number of hours invoiced, it might be possible to identify the number of events or customer calls effectively serviced. In this last case, the selling price and/or the unit cost of the service would be the total (sales revenues or costs) divided by the number of events.

Another simplifying approach is to group the different products in classes. For instance, in a grocery store you may find groups such as fruit and vegetables, dairy products, house cleaning, personal cleaning, and so on.

8.9 Using Fisher Equation or Capital Asset Pricing Model in Forecasting

We have to distinguish two stages in forecasting: the use of past information and the forecasting of new information itself. In using the Fisher equation or relationship, we have to take into account those two stages, as follows.

Historical data ←	→ Forecast
$\text{Real} = \dfrac{1+\text{nominal}}{1+\text{inflation}} - 1$	$\text{Nominal} = (1+\text{real}) \times (1+\text{inflation}) - 1$
• Historical prices of inputs and outputs.	• Use the forecasted inflation rate and the average of the real increase as an input data.
• Expenses.	• Estimate increase in prices
• Calculate the nominal increases, deflate with the inflation rate, calculate an average, and use it as forecast.	• Estimate increase in expenses

Find the risk implicit in the cost of debt as the cost of debt minus the risk-free rate. Risk-free rate can be estimated using the return on treasury bonds. Calculate the average of this risk premium.

Deflate the risk-free rate and calculate the average of this deflated risk-free rate. This is an estimate of the real rate of interest that can be used in the forecasts. In any case, decompose the historical cost of debt in risk premium, real rate of interest, and inflation. Average the risk premium and the real rate to use them in the forecast.

While estimating interest rates and price increases, it is important that nominal and real rates are not mixed up. For instance, in the capital asset pricing model (CAPM), Rf and Rm should be either in nominal or real terms. The usual practice is to use nominal rates because β is usually calculated based on nominal returns.

Nominal and real cost of debt and return on ST investments can be calculated in the same fashion. Real "variables" can be estimated using the Fisher relation backwards

$$\text{Real} = \frac{1+\text{nominal}}{1+\text{inflation}} - 1. \tag{8.4a}$$

With the risk premium for debt estimated from the retrospective financial statements, and the estimate of real interest rates and the prospective inflation rates, estimate the future cost of debt. When preparing a debt schedule, it is a usual practice to use end of the year balances. Interest charges are paid at the end of year, not at the beginning. Make sure that interest payments in the debt schedule are the same you use in the IS and in the CB. In the case of a loan fully paid in the forecasting period, the sum of principal payments should be identical to the initial debt balance. Principal payment at time t is equal to the constant payment at time t minus the interest at time t calculated as $K_{\text{d}} \times (\text{Deb}_{t-1})$. Debt balance for the last year has to be zero (in case the debt is fully paid during the forecasted period). The debt balance at any year (or the sum of all debt balances in case there are several loans) should be identical to the total debt in the BS.

The Central Banks provide an estimate of future inflation. Expected inflation might also be derived from the zero-coupon curve. Link all the rates that are inflation related, to inflation (from any of the approaches mentioned above). For instance, risk-free rate should be composed (using Fisher relationship) of real interest rate and inflation rate. Nominal increase in prices should be linked to inflation as well.

Real increase in prices and inflation play a very critical role in a financial model. We can introduce additional degrees of sophistication by introducing the effect of price elasticity in the model. This might be seen as too sophisticated. However, its use would prevent the analyst from assuming high real price increases scenarios without considering its effect on demand. A good market analysis should provide the management with the sensitivity of the demand to prices.

If foreign exchange currency is used in the financial model, estimate a base exchange rate change using the purchasing power parity model (PPP). Under PPP, the change in foreign exchange rate will be equal to

$$\text{Real} = \frac{1 + \text{domestic inflation rate}}{1 + \text{Foreign inflation}} - 1. \tag{8.4b}$$

We can examine deviations from this base case. A caveat is in order. For instance, if there are revenues in foreign currency, the higher is the domestic inflation, the higher are the revenues and this might contradict the conventional wisdom that inflation destroys value.

8.10 Forecasting Inputs for the Financial Statements

We recommend a step by step approach that simplifies the construction of financial statements. Construct intermediate tables (IT) that include the following:

- Input data (inflation rate, tax rate, real increases, real interest rate, policies, and the like)
- Table for nominal increases in prices
- A basic input variables calculation table to forecast future prices, quantities, total sales, interest rates, and the like
- Depreciation schedule
- Inventory level in units
- COGS
- Sales and purchases
- Inflows from sales and outflows from purchases

With this information the IS can be constructed up to the EBIT line. After this line, we need to know interest charges and interest received. This can be estimated for the first forecast period from the last financial statements. For the second year, we need to construct the CB. The critical lines in the CB are the debt (to check if there is a new debt) and the ST investment.

8.10.1 Increase in Sales Revenues

Calculate the increase in nominal sales revenues (costs and expenses). This increase is composed of the real growth in units, the real increase in prices, and inflation.

8.10.2 Deflate the Nominal Increase

With the appropriate measure of inflation, we can deflate the calculated nominal increase according to the previous item. The resulting number will be a combination of real increase in units (growth) and the real increase in prices. Let us call it the "real" growth rate for sales revenues.

8.10.3 Calculate Average

Calculate the average of these deflated increases and use it as the forecast for the mix of the two input variables: the growth in units and the real increase in prices. In Appendix C, we show an example of how to use the deflator for calculating those forecasts.

We can calculate the increase in sales as

$$\begin{aligned}\text{Increase in Sales Revenues}_t = (1+\text{inflation}_t)\times(1+\text{real growth}_t)\\ \times(1+\text{real increase}_t)-1.\end{aligned}\tag{8.5}$$

If we know the sales revenues for the last historical period, we apply this increase to that value and the same procedure is adopted for the following years. A similar procedure can be adopted for costs and expenses.

The "real" growth for sales revenues above imposes a constraint on the combined effect of real growth in units and real increase in prices. We can estimate one of the two and the other will be defined (using Fisher relation). For instance, estimating real growth in units from the industry GDP would result in an estimate of real increase in prices. The real increase in prices might be estimated as

$$\text{Real increase in price } = \frac{1+\text{“real” growth}}{1+\text{real growth in units}}-1.\tag{8.6}$$

We show an example of this interdependence in Table 8.3.

Cash outflows can be determined using the following relationship:

$$\text{Initial inventory}+\text{Purchases}-\text{Final Inventory}=\text{Cost of goods sold.}$$

Table 8.3 Decomposition of "real" increase in sales revenues

"Real" increase in sales revenues (%)	Increase in volume (%)	Increase in real Price (1 +"real" growth)/(1+real growth in units) – 1 (%)
2.57	0.00	2.57
2.57	0.50	2.05
2.57	1.00	1.55
2.57	1.50	1.05
2.57	2.00	0.55
2.57	2.50	0.06

Depending on the payables policy, one can determine the amount of cash paid for that item. The same is true of overhead, sales and administrative expenses, and so on.

When there is no information for a particular item on the BS, it is better to keep it constant for the forecasting period or even "eliminate" it either by paying it out or realizing cash and this has to be reflected in the CB.

Items such as assets, equity, new equity investment, cumulated retained earnings, equity repurchase, and debt are not to be expressed as a percent of any other figure (say, revenues). These items would change as a result of the different transactions recorded in the IS and the CB. For instance, the amount to be borrowed or the amount to be invested as excess cash will pop up from the CB.

For the sake of consistency, it is important to ensure that all the AR and AP are recovered or paid (from the last historical financial statement).

Matching the BS by adding or subtracting any difference between assets and liabilities and equity must be avoided. This practice might hide some errors that would make analysis and valuation difficult and inconsistent. See the above discussion on the use of plugs and Appendix D.

Provision for bad debts should be subtracted in the IS; applied on the AR in the BS and should be subtracted from revenues in the CB.

If you pay in advance or receive payments in advance in a given period, you have to reduce inflows and outflows by an equal amount in future periods. Split the sales revenues and the payments in three parts as follows:

1. Sales revenues
   a. Payments received in advance (previous period)
   b. Payments received in current period
   c. Payments to be received in the future (AR)
2. Purchases
   a. Payments paid in advance (previous period)
   b. Payments paid in current period
   c. Payments to be paid in the future (AP)

With the previous splitting, we can construct the inflows and outflows for each "slice."

3. Inflows for sales revenues

   a. Payments received in advance (from future sales)
   b. Payments received in current period
   c. Payments received from past periods (AR)

4. Outflows for purchases

   a. Payments paid in advance (from future purchases)
   b. Payments paid in current period
   c. Payments to be paid from past periods (AP)

Useful indexes such as gross margins, AR and AP period, and inventory turnover can be calculated from the financial statements based on deflated figures. Use these indexes as percentage of revenues for those items that are directly linked to revenues. These are known as variable costs. That is they depend on the level of activity. For instance, the higher is the units sold, the higher are the revenues, and the higher is the COGS.

In preparing financial statements, an analyst has to take into account the economic environment and related variables. Identify as much variables as possible that might affect forecasts and try to quantify them. Later on, one might discard some of them either because there is no information or because they are not too relevant.

In the comprehensive example, we show below the reader could imagine the list of input variables needed to forecast financial statements in reality.

8.11 An Example

A hypothetical commercial firm buys a product and sells it at a higher price. The example is based on some input data and from them we derive the complete financial model. The input data are estimated from 5 years of historical financial statements. We start with an initial financial statement (previous year). Imagine that we construct the financial statements by hand; we start from the last historical financial statements, and construct the IS for year 6. We can repeat this process (CB year 6 → IS year 7 → CB year 7 → IS year 8 and so on) until we arrive to the end of the forecasting period. Once the CB and IS are defined, we construct the final BS. The idea is that we cannot construct the IS if we do not know if in the previous period we have contracted new debt or if we have invested some excess cash. This information is the basis to calculate the interest to be paid or received in the next period.

The sole purpose of this exercise is to illustrate the procedure for forecasting.

8.11.1 Use of Historical Statements

We use 5 years of historical financial for forecasting additional 5 years. The historical financial statements are in Tables 8.4 and 8.5. We assume some additional information like the following are available:

- New assets will be bought in year 8 at a price of 65[11]
- LT debt is for 10 years and ST loan is for 1 year
- Taxes are paid the same year as accrued
- Straight line depreciation is used for 4 years[12]
- Prices, quantities, and the debt schedule for the outstanding debts are known

From the historical financial statements, we can estimate policies and some input data for the forecasting as shown in Table 8.6.

In the previous table, dividends to be paid in year 6 are calculated from the net income of year 5 and the policy of dividends. From the selling and purchasing prices and expenses in the IS, we can estimate the nominal and real price increases. We also calculate the nominal and "real" increase in sales revenues.

For instance in the previous table, cash as a percentage of sales is calculated for year 4 as

$$13/479.3 = 2.71\%.$$

Table 8.4 Historical income statement

Year	1	2	3	4	5
Sales revenues	381.4	410.1	444.4	479.3	515.5
Cost of goods sold (COGS)	270.3	289.2	312.5	334.8	358.9
Gross income	111.1	120.9	131.9	144.6	156.6
Overhead expenses	23.4	25.0	26.5	28.0	29.6
Administrative and selling expenses	52.5	56.5	60.7	65.0	69.2
Depreciation	11.3	11.3	11.3	11.3	14.1
Earnings before interest and taxes (EBIT)	23.9	28.2	33.5	40.3	43.8
Interest payments.	8.9	5.1	3.4	2.4	7.0
Return (interest) from short-term (ST) investment	0.0	0.0	0.6	2.2	0.0
Earnings before taxes (EBT)	15.0	23.1	30.7	40.2	36.8
Income taxes	5.2	8.1	10.7	14.1	12.9
Net income	9.7	15.0	19.9	26.1	23.9

[11] We can design sophisticated procedures in a spreadsheet to define when to invest in fixed assets depending on the available capacity and the lead time of receipt of the new asset.

[12] We use a depreciation life of 4 years only for illustration purposes. We should note that usual depreciation lives are 5, 10, and 20 years depending on the class of assets.

Table 8.5 Historical balance sheet

Year	1	2	3	4	5
Assets					
Cash	10.0	11.0	12.0	13.0	14.0
Accounts receivable (AR)	22.9	24.6	17.8	33.6	15.5
Inventory	22.6	23.2	28.3	28.6	30.3
Short-term investments	0.0	7.8	28.3	0.0	30.7
Current assets	55.5	66.6	86.4	75.1	90.4
Total net fixed assets	33.8	22.5	11.3	56.3	42.2
Total	89.27	89.15	97.62	131.44	132.61
Liabilities and equity					
Accounts payable (AP)	27.3	31.9	38.1	23.5	28.8
Short-term debt	6.0	0.0	0.0	0.0	0.0
Current liabilities	33.3	31.9	38.1	23.5	28.8
Long-term debt	31.3	24.5	17.8	55.5	44.3
Total liabilities	64.6	56.4	55.9	79.0	73.2
Equity investment	15.0	15.0	15.0	15.0	15.0
Retained earnings	0.0	2.7	6.8	11.4	20.5
Current year net income	9.7	15.0	19.9	26.1	23.9
Repurchase of equity	0.0	0.0	0.0	0.0	0.0
Total liabilities and equity	89.27	89.15	97.62	131.44	132.61

Table 8.6 Estimation of policies

Year	0	1	2	3	4	5	Average
Cash in balance sheet (BS)		10.0	11.0	12.0	13.0	14.0	
Cash as % of sales		2.62%	2.68%	2.70%	2.71%	2.72%	2.69%
Sales revenues		381.4	410.1	444.4	479.3	515.5	
Inventory	20.00	22.64	23.25	28.26	28.59	30.26	
Cost of goods sold (COGS)		270.35	289.23	312.55	334.75	358.86	
Inventory policy = inventory/COGS as %		8.37%	8.04%	9.04%	8.54%	8.43%	8.49%
Accounts receivables (AR)		22.9	24.6	17.8	33.6	15.5	
AR policy = AR/Sales revenues as %		6.00%	6.00%	4.00%	7.00%	3.00%	5.20%
Purchases = final inv. – beginning inv. + COGS		272.98	289.84	317.56	335.08	360.54	
Accounts payables (APs)		27.30	31.88	38.11	23.46	28.84	
AP policy = AP/purchases as %		10.00%	11.00%	12.00%	7.00%	8.00%	9.60%
Cumulated retained earnings	0.00	0.00	2.72	6.78	11.36	20.50	
Net income	0.00	9.72	15.02	19.93	26.12	23.93	
Dividends		0.0	7.0	11.0	15.3	17.0	
$Dn - 1 = RNn - 1 - RNn + NIn$							
Payout ratio = dividends/net income			72.0%	73.0%	77.0%	65.0%	71.8%

The inventory policy for year 3 is calculated as
$22.9/312.55 = 9.04\%$
Purchases for year 2 are calculated as
Purchases = Final Inv – Beginning Inv + COGS
$= 23.25–22.64 + 289.23 = 289.84$

Dividends are calculated from retained earnings, RNI, and net income using the following relationship:

$D_{n-1} = RNI_{N-1} - RNI_N + NI_N$.
For year 3, we have $17.9–26.7 + 19.8 = 11.0$

The firm usually provides the debt repayment schedules for the outstanding debt. This hypothetical firm has two LT loans outstanding. The debt schedules for the two loans are shown in Table 8.7. The information from these tables will be included in the CB.

In addition, there exists some extra information on quantities and prices, as shown in Table 8.8.

The LT loan contracted before year 1 is repaid by year 5. The new LT loan contracted in year 4 is repaid in equal principal payments in 10 years. This information

Table 8.7 Debt repayment schedule for debt contracted in the past

Year	Payments loan in year 0, L_0	Payments L_1	Interest L_1	Payments L_4	Interest L_4
1	6.0				
2	6.0	0.73	0.99		
3	6.0	0.73	0.91		
4	6.0	0.73	0.77		
5	6.0	0.73	0.64	4.44	5.57
6		0.73	0.53	4.44	4.88
7		0.73	0.42	4.44	4.15
8		0.73	0.32	4.44	3.47
9		0.73	0.24	4.44	2.98
10		0.73	0.16	4.44	2.48
11		0.73	0.08	4.44	1.99
12				4.44	1.49
13				4.44	0.99
14				4.44	0.50

Table 8.8 Additional data not found in the financial statements

Year	1	2	3	4	5
Inflation	6.0%	5.5%	5.5%	5.0%	4.5%
Risk-free (Rf) rate	9.18%	8.66%	8.66%	8.15%	7.63%
Q sold	51.0	51.4	52.3	53.1	54.2
Selling price	7.5	8.0	8.5	9.0	9.5
Purchasing price	5.33	5.65	6.01	6.34	6.65

Table 8.9 Estimation of historical nominal and real price increases

Year	1	2	3	4	5	Average
Overhead expenses	23.44	24.97	26.45	28.00	29.61	
Nominal increase in overhead expenses		6.8%	6.7%	6.6%	6.3%	5.3%
Real increase in overhead expenses		1.00%	0.40%	0.80%	1.20%	0.85%
Administrative and selling expenses	52.52	56.49	60.72	64.98	69.19	
Nominal increase in administrative and selling expenses		7.56%	7.48%	7.03%	6.48%	
Real increase in administrative and selling expenses		1.95%	1.87%	1.93%	1.89%	1.91%
Nominal increase in selling price		6.66%	6.56%	6.26%	5.34%	
Real increase in selling price		1.10%	1.00%	1.20%	0.80%	1.03%
Nominal increase in purchasing price		6.13%	6.24%	5.53%	4.92%	
Real increase in purchasing price		0.60%	0.70%	0.50%	0.40%	0.55%
Nominal increase in sales revenues		7.51%	8.37%	7.85%	7.55%	
"Real" increase in sales revenues		1.91%	2.72%	2.72%	2.92%	2.57%
Gross margin	29.13%	29.47%	29.67%	30.16%	30.39%	29.76%
Tax rate = taxes/EBT (earning before taxes)	35.00%	35.00%	35.00%	35.00%	35.00%	35.00%

is to be included in the CB. Table 8.9 presents the estimation of historical nominal and real price increases.

We have inflation and risk-free rate from the information in Table 8.6. Using this information, we can estimate nominal and real interest rates, risk premium on debt, and ST investment. The estimation of cost of debt and return on ST investment is presented in Table 8.10.

From the IS and the BS, we can extract relevant information to estimate interest rates. For instance, in Table 8.10, to find the cost of debt for each year we divide the financial expenses (interest paid) for the year, by the debt in the previous year. For year 5, we have, $K_{d5} = 7.0/55.5 = 12.54\%$. The risk premium is K_d minus the risk-free rate. For year 5, it is 12.54%–6.59% = 4.9%.[13] In a similar fashion, we calculate the return for the ST investment. For both, we calculate the average and use it as an input data.

[13] The other approach is to use the yield on the company's bonds and use the term structure of interest rates to forecast future rates.

Table 8.10 Estimation of cost of debt and return on short-term (ST) investment

Year	1	2	3	4	5	Average
Interest paid		5.1	3.4	2.4	7.0	
Debt (total)	37.3	24.5	17.8	55.5	44.3	
Interest rate paid		13.59%	13.97%	13.35%	12.54%	
Risk-free (Rf) rate		8.66%	9.72%	6.05%	6.59%	
Risk premium in debt = Interest rate paid – Rf		4.92%	5.30%	5.20%	4.90%	5.08%
Interest received	–	–	0.64	2.22	0.00	
ST term investment	0.0	7.8	28.3	0.0	30.7	
Interest rate received	NC	NC	8.18%	7.85%	NC	
Risk premium in ST investment	NC	NC	–0.49%	–0.30%	NC	–0.39%

8.11.2 Forecasting Financial Statements

From the previous tables and external information, we construct a table of input data as follows (see Table 8.11):

The real interest rate can be estimated by deflating the risk-free rate and averaging it. Another option is to look for reports from research in universities and/or the Central Bank. Expected inflation rate can be obtained from Central Bank estimates. Growth of volume in units is estimated using the investment in physical assets.

With these input data, we can construct three financial statements: The CB, the IS, and the BS. In the next table, we show the procedure to do this. We start with some IT and we end with the financial statements. Table 8.12 presents the nominal increase in prices and growth in units.

For instance, the nominal increase in selling price for year 6 from Table 11 is $(1 + 1.03\%) \times (1 + 4.00\%) - 1 = 5.1\%$.

In Table 8.13, we show the forecast of other variables.

In the previous table, sales in units for year 8 is $59.2 = 57.5 \times 1.03$.

When we forecast prices and volume using the average of real increase in price and the average of increase in volume, we are splitting the "real" increase in sales revenues in two. In that specific case, it is the same to forecast prices and volume or sales revenues. Usually, we forecast volume based on the growth of the demand driver (population, construction, car production, etc.) and not using the average of past volume increases. In general, we would forecast a real growth in volume (units) that is linked not to the average of historical growth of units but to a forecast growth based on the demand driver and/or the explicit investment in operating assets. In general, they are not identical. See Table 8.14.

In Table 8.15, we show the depreciation and investment schedule.

We assume that the firm invests in fixed assets an amount equal to the depreciation charges. In addition, we assume that in year 8 there will be an extra investment in fixed assets (see Table 8.11). The previous table shows the calculation

Table 8.11 Input data

Year	6	7	8	9	10
Corporate tax rate (Table 8)	35.0%	35.0%	35.0%	35.0%	35.0%
Inflation rate (external information)	4.0%	3.5%	3.0%	3.0%	3.0%
Real increase in selling price (Table 8)	1.03%	1.03%	1.03%	1.03%	1.03%
Real increase in purchase price (Table 8)	0.55%	0.55%	0.55%	0.55%	0.55%
Real increase in overhead expenses (Table 8)	0.85%	0.85%	0.85%	0.85%	0.85%
Real increase in payroll expenses (Table 8)	1.91%	1.91%	1.91%	1.91%	1.91%
Increase in sales volume (units) (internal estimates)	3.00%	3.0%	3.0%	4.0%	4.0%
Real interest rate (external information)	3.00%	3.00%	3.00%	3.00%	3.00%
Risk premium for cost of debt (Table 9)	5.08%	5.08%	5.08%	5.08%	5.08%
Risk premium for short-term (ST) investment (Table 9)	−0.39%	−0.39%	−0.39%	−0.39%	−0.39%
Policies and goals					
Inventory as % of cost of goods sold (COGS) (Table 5)	8.49%	8.49%	8.49%	8.49%	8.49%
Accounts receivable as % of sales (Table 5)	5.20%	5.2%	5.2%	5.2%	5.2%
Accounts payable as % of purchases (Table 5)	9.50%	9.5%	9.5%	9.5%	9.5%
Payout ratio (Table 5)	71.75%	71.8%	71.8%	71.8%	71.8%
Minimum cash required as % of sales revenues (Table 5)	2.69%	2.69%	2.7%	2.7%	2.7%
Repurchase of equity as % of depreciation	0.0%	0.0%	0.0%	0.0%	0.0%
New investment is year 8			65.0		

of depreciation included the new investment of an operating asset by $65.0 in year 8 and the investment of depreciation every year. For instance, depreciation in year 6 is 14.1 and so is the new investment. Depreciation of year 7 of that new investment is 3.5 (14.1/4). This new depreciation adds to the previous one and we arrive to 17.6 in year 7.

Table 8.12 Nominal increase in prices and growth in units

Year	6	7	8	9	10
Selling	5.1%	4.6%	4.1%	4.1%	4.1%
Purchase	4.6%	4.1%	3.6%	3.6%	3.6%
Overhead expenses	4.9%	4.4%	3.9%	3.9%	3.9%
Payroll expenses	6.0%	5.5%	5.0%	5.0%	5.0%
Increase factor in volume	3.0%	3.0%	3.0%	4.0%	4.0%

Table 8.13 Basic input variables calculation

Year	5	6	7	8	9	10
Sales in units, Q	54.2	55.8	57.5	59.2	61.6	54.2
Selling price, P	9.5	10.0	10.5	10.9	11.3	9.5
Total sales	515.5	557.9	600.8	643.9	696.9	515.5
Forecast for unit cost	6.65	6.95	7.24	7.49	7.76	8.04
Price of asset in year 8				65.0		
Risk-free (Rf) rate		7.12%	6.60%	6.09%	6.09%	6.09%
Return of short-term investment		6.73%	6.21%	5.70%	5.70%	5.70%
Cost of debt, K_d, from CAPM = Rf + risk premium in cost of debt		12.20%	11.69%	11.17%	11.17%	11.17%
Minimum cash		14.99	16.14	17.30	18.72	20.26

Table 8.14 Comparison of forecasting sales revenues using two approaches

Year	5	6	7	8	9	10
Real increase in selling price		1.03%	1.03%	1.03%	1.03%	1.03%
Increase in sales volume (units)		3.00%	3.00%	3.00%	4.00%	4.00%
Inflation rate		4.0%	3.5%	3.0%	3.0%	3.0%
Forecast of sales revenues as P × Q (T. 12)	515.5	557.87	600.81	643.93	696.85	754.12
Average of “real” increase ((1+nominal inc. sales revenues)/(1 + inflation rate) – 1) in sales revenues (T. 8)		2.57%	2.57%	2.57%	2.57%	2.57%
Nominal increase in sales revenues		6.67%	6.15%	5.64%	5.64%	5.64%
Forecast of sales revenues from the IS	515.5	549.88	583.72	616.66	651.45	688.20
Average Gross margin (T. 8)		29.76%	29.76%	29.76%	29.76%	29.76%
COGS = sales revenues × (1 – average gross margin)		386.21	409.98	433.11	457.55	483.36

Table 8.15 Depreciation schedule

Year	5	6	7	8	9	10
Beginning fixed assets		42.2	42.2	42.2	107.2	107.2
Depreciation investment year 4	14.1	14.1	14.1	14.1		
Depreciation investment year 5		0.0	0.0	0.0	0.0	
Depreciation investment year 6			3.5	3.5	3.5	3.5
Depreciation investment year 7				4.4	4.4	4.4
Depreciation investment year 8					21.7	21.7
Depreciation investment year 9						7.4
Annual depreciation		14.1	17.6	22.0	29.7	37.1
Cumulated depreciation	59.1	73.2	90.7	112.7	142.4	179.5
New fixed assets		14.1	17.6	87.0	29.7	37.1
Net fixed assets	42.2	42.2	42.2	107.2	107.2	107.2

Table 8.16 Inventory and purchases in units

Year	5	6	7	8	9	10
Units sold (T. 12)	54.18	55.81	57.48	59.20	61.57	64.04
Final inventory in units	4.55	4.74	4.88	5.02	5.22	5.43
Initial inventory in units	4.51	4.55	4.74	4.88	5.02	5.22
Purchases in units		55.99	57.62	59.35	61.77	64.24
Forecasted unitary cost	6.65	6.95	7.24	7.49	7.76	8.04

In the Table 8.16, we calculate the units to be purchased and in inventory. This is based on the forecast of units sold and the inventory policy. Purchases in units can be derived from the level of inventory as follows:

$$\text{Final inventory, FI} = \text{Initial inventory, II} + \text{Purchases, } P - \text{Units sold, } S, \tag{8.7a}$$

$$P = \text{FI} - \text{II} + S. \tag{8.7b}$$

From the BS in year 5 and purchasing price in Table 8.8, we estimate the inventory in year 5 in units as 4.6 (30.3/6.65).

Purchases in units for year 6 are 55.99 ($4.74 - 4.55 + 55.81$). The reader should verify that final inventory is 8.49% of the sales in units.

Final inventory is calculated as units in inventory time unit cost. For instance, for year 6, we have $6.95 \times 4.74 = 32.9$. COGS for year 6 is initial inventory + purchases – final inventory $= 30.3 + 389.3 – 32.9 = 386.7$. Compare the COGS calculated in Table 8.17 with the one calculated based on the forecast for sales revenues and the average gross margin in the Table 8.14. We prefer and recommend, when possible, the approach presented in Table 8.17.

To calculate expenses, we apply the nominal increase to the previous value of the expense.

In Table 8.18, we split sales and purchases in inflows and outflows according to the AR and AP policies.

Table 8.17 Cost of goods sold (COGS) and overhead and administrative and selling expenses calculation

Year	5	6	7	8	9	10
Initial inventory in dollars		30.3	32.9	35.3	37.6	40.6
Purchases in dollars		389.3	417.0	444.8	479.5	516.4
Final inventory in dollars	30.3	32.9	35.3	37.6	40.6	43.7
COGS		386.7	414.6	442.4	476.6	513.3
Overhead expenses	29.6	31.1	32.4	33.7	35.0	36.3
Administrative and selling expenses	69.2	73.3	77.4	81.2	85.2	89.5

Table 8.18 Sales and purchases

Year	6	7	8	9	10
Total sales revenues (T. 13)	557.9	600.8	643.9	696.9	754.1
Credit sales (% from T. 10)	29.0	31.2	33.5	36.2	39.2
Inflow of sales revenues for current year	528.9	569.6	610.4	660.6	714.9
Total purchases (T. 16)	389.3	417.0	444.8	479.5	516.4
Purchases on credit (% from T. 10)	37.4	40.0	42.7	46.0	49.6
Purchases paid the same year	351.9	376.9	402.1	433.4	466.9

Table 8.19 Inflows from sales and outflows for purchases

Year	6	7	8	9	10
Inflow of sales revenues for current year	528.9	569.6	610.4	660.6	714.9
Inflows from accounts Receivables	15.5	29.0	31.2	33.5	36.2
Total inflows	544.3	598.6	641.7	694.1	751.1
Purchases paid the current year	351.9	376.9	402.1	433.4	466.9
Payment of accounts payable	28.8	37.4	40.0	42.7	46.0
Total payments for purchases	380.8	414.3	442.1	476.1	512.9

In Table 8.18, we calculate how much of the sales revenues are received the same period they are invoiced and how much is left as AR for the next period. In the same fashion, we calculate that for the purchases. For instance, in the previous table we split the sales for year 6 (557.9) in inflow of sales for current year as credit sales (sales revenues $\times$ % of AR, $557.9 \times 5.2\% = 29.0$) and the rest of sales will be received in year 7. In a similar fashion, we calculate the outflows for purchases. In Table 8.19, we place each amount in the respective year.

In the previous table, we have placed each amount in the period in which it will be received. With all these input data, we construct the CB (Table 8.20). In the CB, we link input data and IT, with some lines from the IS. Remember that all financial statements are intertwined.

Observe that interest paid and received depend on previous balance of debt and marketable securities (ST investment). Dividends depend on net income of previous year and dividends policy as well.

It is necessary that the reader understands the clue in the CB calculation. There are two relevant issues to avoid plugs and circularity. One is the calculation of debt (ST and LT) and the other one is the cash excess invested in marketable securities.

Table 8.20 Cash budget (In parenthesis the table the data are taken from)

Year	6	7	8	9	10
Module 1: operating activities					
Cash inflows					
Total accounts receivable (AR) plus sales on cash (Table 18)	544.3	598.6	641.7	694.1	751.1
Total inflows	544.3	598.6	641.7	694.1	751.1
Cash outflows					
Total payments for purchases (Table 18)	380.8	414.3	442.1	476.1	512.9
Overhead and administrative and selling expenses (Table 16)	104.4	109.8	114.9	120.2	125.8
Income taxes (From IS below, Table 21)	17.3	19.7	22.0	22.7	25.6
Total cash outflows	502.5	543.8	579.0	619.0	664.3
Net cash balance (NCB) before fixed assets purchase	41.9	54.8	62.7	75.1	86.8
Module 2: investment in assets					
Purchase of fixed assets (Table 14)	14.1	17.6	87.0	29.7	37.1
NCB of investment in assets	−14.1	− − 17.6	–87.0	–29.7	–37.1
NCB after fixed assets investment	27.8	37.2	–24.3	45.4	49.8
Module 3: external financing					
Inflow of loans					
ST (short-term) loan	0.0	0.0	0.0	0.0	0.0
LT (long-term) loan 10 years	0.00	0.00	21.56	0.00	0.00
Payment of loans					
Principal ST loan	0.0	0.0	0.0	0.0	0.0
Interest ST loan	0.0	0.0	0.0	0.0	0.0
Principal LT loan (Table 6 and 20, below)	5.2	5.2	5.2	7.3	7.3
Interest LT loan (Table 6 and 20, below)	5.4	4.6	3.8	5.6	4.8
NCB of financing activities	−10.6	−9.7	12.6	–13.0	–12.1

(continued)

Table 8.20 (continued)

Year	6	7	8	9	10
Module 4: transactions with owners					
Initial invested equity					
Dividends payment (Table 21)	17.2	23.0	26.2	29.4	30.2
Repurchase of stock (Table 21)	0.0	0.0	0.0	0.0	0.0
NCB of transactions with owners	–17.2	–23.0	–26.2	–29.4	–30.2
NCB for the year after previous transactions	0.0	4.4	–38.0	3.1	7.4
Module 5: discretionary transactions					
Redemption of ST investment (Table 4b for year 6)	30.7	31.8	37.0	0.0	1.7
Return from ST investments	2.1	2.0	2.1	0.0	0.1
ST investments	31.77	37.01	0.00	1.68	7.65
NCB of discretionary transactions	1.0	–3.3	39.1	–1.7	–5.9
Year NCB	0.99	1.15	1.16	1.42	1.54
Cumulated NCB (check with Table 12)	14.99	16.14	17.30	18.72	20.26

The model checks if there is a deficit or an excess of cash. The first equation for calculating ST debt is the following:

$$\text{Net cash balance NCB before fixed assets purchase} - \text{Interest ST loan} \\ - \text{Principal ST loan} > 0. \tag{8.8a}$$

For year 7, we have $54.8 - 0.0 - 0.0 > 0$ hence there is no need for a ST loan. If negative, then there exists a deficit and there will be a ST loan by an amount equal to the absolute value of the deficit. If positive, then there is no need for a loan. All the elements in the formula are from the current year except the cumulated NCB that comes from the previous year. Observe that principal payments and interest payments in (8.8a) have been defined from a debt contracted in previous years. In this analysis, we consider only ST items, such as the operating NCB (NCB before fixed assets purchase).

The second formula is for the LT debt. The equation for LT debt is the following:

$$\begin{aligned}&\text{NCB after fixed assets investment} + \text{ST Loan} - \text{Principal ST loan}\\&- \text{Interest ST loan} - \text{Principal LT loan} - \text{Interest LT loan}\\&+\ \text{NCB of transactions with owners} +\ \text{Redemption of short term ST investment}\\&+\ \text{Return from ST investments} - \text{Minimum cash}\\&+\ \text{Cumulated NCB (previous period)} > 0.\end{aligned} \tag{8.8b}$$

If this is negative, the company contracts a loan for the absolute value of the deficit. If not, they do not. All the elements in the formula are from the current year, except the cumulated NCB that comes from the previous year. Observe that principal payments and interest payments in (8.8b) have been defined from a debt contracted in *previous* years.

For instance, at year 8, we have

$$\begin{aligned}&-24.33+0.00-0.00-0.00-5.17-3.80-26.23+37.01+2.11-17.30+16.14\\&\quad = -21.57 < 0.\end{aligned}$$

As this is negative, it is a deficit and the firm has to contract a LT loan for the amount of 21.57.

For the cash excess, we have the following:

$$\begin{aligned}&\text{NCB for the year after previous transactions} + \text{Redemption of short term ST}\\&\quad + \text{investment Return from ST investments} + \text{Cumulated NCB (previous period)}\\&\quad - \text{Minimum cash} > 0.\end{aligned} \tag{8.9}$$

If this is positive, there is cash excess and the model invest that amount. All the elements in the formula are from the current year, except the cumulated NCB that comes from the previous year. Observe that redemption of and return from ST investment in (8.11.2) has been defined from an investment made in *previous* years.

For instance, for year 7 we have

$$= 14.99+4.4+31.8+2-16.14 = 37.05 \text{ (please, allow for rounding errors).}$$

The first thing we can see in the CB is that the model shows that we will need a new LT loan in year 8. For illustration purposes, we show an additional line in the debt schedule to show the new LT loan. Table 8.21 presents the LT loan schedule.

From the BS of year 5, we can calculate interest charges and return from ST securities and then we can complete the IS and the CB for year 6. The interest charges are calculated as $Kd_t \times$ Total deb_{t-1} $(11.58\% \times (0.0+44.4)) = 5.14$. In the same fashion, we calculate the return on ST securities.

In Table 8.22, we show the forecast for the IS.

Observe that interest payments and return on ST investments depend on previous balances for each year.

Table 8.21 Long-term (LT) loan schedule (includes old debt)

Year	6	7	8	9	10
Beginning balance	44.4	39.2	34.0	37.7	31.6
Interest payment LT	5.4	4.6	3.8	5.6	4.8
Principal payments LT	5.2	5.2	5.2	7.3	7.3
Total payment LT	10.6	9.7	9.0	13.0	12.1
New debt	0.0	0.0	21.6	0.0	0.0
Ending balance	39.2	34.0	50.4	43.1	35.7
Interest rate	11.58%	10.65%	10.14%	10.14%	10.14%

Table 8.22 Income statement

Year	5	6	7	8	9	10
Sales revenues (Table 12)	515.5	557.9	600.8	643.9	696.9	754.1
COGS (Table 16)	358.9	386.7	414.6	442.4	476.6	513.3
Gross Income	156.6	171.2	186.2	201.5	220.3	240.8
Overhead expenses (Table 16)	29.6	31.1	32.4	33.7	35.0	36.3
Administrative and selling expenses (Table 16)	69.2	73.3	77.4	81.2	85.2	89.5
Depreciation (Table 14)	14.1	14.1	17.6	22.0	29.7	37.1
Earnings before interest and taxes (EBIT)	43.8	52.7	58.8	64.6	70.4	77.9
Interest payments (Tables 19 and 20)	7.0	5.4	4.6	3.8	5.6	4.8
Return (interest) from short-term investment (Table 19)	0.0	2.1	2.0	2.1	0.0	0.1
Earnings before taxes (EBT)	36.8	49.4	56.2	62.9	64.8	73.2
Income taxes	12.9	17.3	19.7	22.0	22.7	25.6
Net income	23.9	32.1	36.6	40.9	42.1	47.6
Dividends	17.4	23.0	26.2	29.4	30.2	34.1
Cumulated retained earnings	20.6	27.3	36.3	46.7	58.2	70.1
Repurchase of equity	0.0	0.0	0.0	0.0	0.0	0.0

As historical financial statements do not give the information on dividends to be paid in the next year, we have to use the estimate of dividend policy from Table 8.6. With this policy we calculate the dividends to be paid from year 6–10 and based on the previous net income. For instance, the dividend to be paid in year 6 is calculated from the net income of year 5 and the dividend policy ($17.4 = 24.3 \times 71.8\%$).

On the contrary, with the IS for year 5 we calculate the tax for year 6. Hence, we can construct the CB for year 6. In fact, as taxes are assumed to be paid the same year as accrued, the tax payment for year 6 is known. If taxes were paid the following year, the tax calculated in year 5 allows us to construct the CB for year 6. When we construct the CB for year 6–10, we can construct successively the IS for those years.

Table 8.23 Forecast balance sheet

Year		6	7	8	9	10
Assets						
Cash	CB (T. 19)	15.0	16.1	17.3	18.7	20.3
Accounts receivable	IT (T. 17)	29.0	31.2	33.5	36.2	39.2
Inventory	IT (T. 16)	32.9	35.3	37.6	40.6	43.7
Short-term investments	CB (T. 19)	31.8	37.0	0.0	1.7	7.6
Current assets	Sum	108.7	119.7	88.4	97.2	110.8
Total net fixed assets	IT (T. 14)	42.2	42.2	107.2	107.2	107.2
Total		150.92	161.92	195.66	204.42	218.02
Liabilities and equity						
Accounts payable	IT (T. 17)	37.4	40.0	42.7	46.0	49.6
Short-term debt	CB (T. 19)	0.0	0.0	0.0	0.0	0.0
Current liabilities	Sum	37.4	40.0	42.7	46.0	49.6
Long-term debt	CB (T. 19)	39.2	34.0	50.4	43.1	35.7
Total liabilities	Sum	76.5	74.0	93.1	89.1	85.3
Equity investment	ID (T. 4b)	15.0	15.0	15.0	15.0	15.0
Retained earnings	IS (T. 21)	27.3	36.3	46.7	58.2	70.1
Current year net income	IS (T. 21)	32.1	36.6	40.9	42.1	47.6
Repurchase of equity	IS (T. 21)	0.0	0.0	0.0	0.0	0.0
Total liabilities and equity	Sum	150.92	161.92	195.66	204.42	218.02

IT intermediate tables, *ID* input data, *CB* cash budget

In practical terms, the IS has been constructed from previous tables; and most of the items (up to EBIT) from IT.

Once we have the CB and the IS for years 6–10, we can construct the BS for the same years. In a spreadsheet, all this happens simultaneously because the three financial statements are intertwined. In Table 8.23, we show the BS for years 6–10. For illustration, we have added a new column for illustration purposes, where we show where each item value is taken from.

In this table, CB = cash budget; IT = intermediate tables; ID = input data and sum indicates that we have to add up lines above. In practical terms, the BS has been constructed from previous tables, most of them from IT.

Now we can compare the behavior of the forecast with the historical one and we can assess if our forecasts are in line with what has happened in previous years or not. This comparison will give us some insight of any drastic deviation from the historical situation. Major deviations have to be understood, justified, and explained. Table 8.24 presents selected indexes from historical and forecasted financial statements.

In the previous table, gross margin is defined as gross income divided by sales revenues; operating margin is EBIT divided by sales revenues; net margin is net income divided by sales revenues; and finally, EBITDA is EBIT plus depreciation (and amortization).

In this example, we identify a drop in operating and net margins (in year 5) due to the new investment in operating assets. This investment resulted in significant

Table 8.24 Selected indexes from historical and forecasted financial statements

Year	1	2	3	4	5	6	7	8	9	10
Gross margin	29.1%	29.5%	29.7%	30.2%	30.4%	30.7%	31.0%	31.3%	31.6%	31.9%
Operating margin	3.9%	5.6%	6.9%	8.4%	7.1%	8.9%	9.4%	9.8%	9.3%	9.7%
Net margin	2.5%	3.7%	4.5%	5.4%	4.6%	5.8%	6.1%	6.4%	6.0%	6.3%
EBITDA	35.1	39.4	44.7	51.6	57.8	66.8	76.4	86.6	100.1	115.0
EBITDA/sales revenues	9.2%	9.6%	10.1%	10.8%	11.2%	12.0%	12.7%	13.5%	14.4%	15.3%

depreciation and debt (interest charges). However, when we examine EBITDA and EBITDA margins we find a regular pattern in their behavior.

In addition to this time series analysis, we should compare the indexes with the industry peers.

In the next section, we show how we can derive the cash flows for valuation purposes from the financial statements.

8.12 From Cash Flows to Firm Value

In this section, we will derive the cash flows for a firm. These cash flows will be the basis to calculate the market value of the firm and specifically the market value of equity.

In their seminal papers, Modigliani and Miller (1958, 1959, and 1963) proposed a basic idea that in a perfect market where no taxes exist the total value of a firm is unchanged by the way the assets are owned. The capital structure of the firm does not affect the total value. Capital structure is the financing structure of the firm. In other words, how it is financed, how much is debt and how much is equity. This is

$$V^{\text{Unlevered}} = E^{\text{Unlevered}} = V^{\text{Levered}} = E^{\text{Levered}} + D, \tag{8.10a}$$

where $V^{\text{Unlevered}}$ is the value of the unlevered (without debt) firm, $E^{\text{Unlevered}}$ is the value of the unlevered equity, E^{Levered} is the value of equity when the firm has debt and D is the market value of debt. This means that under this hypothetical situation (when there are no taxes), capital structure does not affect firm value.

We know that

$$\text{FCF} = \text{CFD} + \text{CFE}, \tag{8.10b}$$

where FCF is the free cash flow, CFD is the cash flow to debt, and CFE is the cash flow to equity.

On the contrary, they established that when taxes exist this externality creates an additional value that has been called the value of the tax shields or tax savings for paying interest. In this case, capital structure does affect the value of the firm, as follows.

$$V^{\text{Levered}} = V^{\text{Unlevered}} + V^{\text{TS}} = E^{\text{Levered}} + D, \tag{8.10c}$$

where V^{TS} is the value of tax shields, other terms where defined above. By the same token, we can associate cash flows to each element of the last equation, as follows.

$$\mathrm{FCF} + \mathrm{TS} = \mathrm{CFD} + \mathrm{CFE} = \mathrm{CCF}, \tag{8.10d}$$

where TS is the tax shield or tax savings and CCF is the capital cash flow (see Ruback, 2002). It has to be noticed that CFE in (8.10b) is different in value from the CFE in (8.10d). The CFE in (8.10d) is larger than CFE in (8.10b) and the difference is the TS.

We will see how we can derive these cash flows from the pro forma financial statements. The basic idea is to identify how much cash the owners of the right-hand side terms of the equations receive. These owners are the debt holders and the equity holders.

We can derive the cash flows in a direct or indirect way. The direct method is easier. This means that we identify directly the amounts of cash flows from the CB.

8.12.1 Cash Flow to Debt

Lenders supply the firm with loans and they receive as compensation the amount the firm borrowed plus the contractual interest. The interesting thing is that the CB already has this amount calculated. See the Module 3 in the CB (shown in Table 8.25).

The CFD is the net value in the NCB of financing activities but with the sign reversed. Remember that the debt owners "invest" their money in the firm, hence it is an outflow and receive the principal payment plus interest. These are inflows for them.

Table 8.26 presents the calculation of CFD from the CB.

Table 8.25 Module 3: external financing, from cash budget

Year	6	7	8	9	10
Module 3: external financing					
ST (short-term) loan	0.0	0.0	0.0	0.0	0.0
LT (long-term) loan 10 years	0.00	0.00	21.56	0.00	0.00
Payment of loans					
Principal ST loan	0.0	0.0	0.0	0.0	0.0
Interest ST loan	0.0	0.0	0.0	0.0	0.0
Principal LT loan	5.2	5.2	5.17	7.3	7.3
Interest LT loan	5.4	4.6	3.80	5.6	4.8
Net cash balance (NCB) of financing activities	−10.6	−9.7	12.59	−13.0	−12.1

Table 8.26 Calculation of cash flow to debt (CFD) from the cash budget (CB)

Year	6	7	8	9	10
Module 3: external financing					
ST (short-term) loan (minus)	0.0	0.0	0.0	0.0	0.0
LT (long-term) loan 10 years (minus)	0.00	0.00	21.56	0.00	0.00
Payment of loans					
Principal ST loan (plus)	0.0	0.0	0.0	0.0	0.0
Interest ST loan (plus)	0.0	0.0	0.0	0.0	0.0
Principal LT loan (plus)	5.2	5.2	5.17	7.3	7.3
Interest LT loan (plus)	5.4	4.6	3.80	5.6	4.8
CFD	10.6	9.7	−12.59	13.0	12.1

Table 8.27 Module 4: transactions with owner, from the cash budget (CB)

Year	6	7	8	9	10
Module 4: transactions with owners					
Initial invested equity	0.0	0.0	0.00	0.0	0.0
Dividends payment	17.2	23.0	26.23	29.4	30.2
Repurchase of stock	0.0	0.0	0.00	0.0	0.0
Net cash balance (NCB) of transactions with owners	−17.2	−23.0	−26.23	−29.4	−30.2

Table 8.28 Calculation of cash flow to equity (CFE) from the cash budget (CB)

Year	6	7	8	9	10
Module 4: transactions with owners					
Equity investment (minus)	0.0	0.0	0.00	0.0	0.0
Dividends payment (plus)	17.2	23.0	26.23	29.4	30.2
Repurchase of stock (plus)	0.0	0.0	0.00	0.0	0.0
CFE	17.2	23.0	26.23	29.4	30.2

8.12.2 Cash Flow to Equity

Using the same approach, we can identify the CFE (see Tables 8.27 and 8.28).

The CFE is the NCB of transactions with owners but with reversed sign. The CFE is just the same numbers with negative sign.

8.12.3 The Capital Cash Flow

The sum of the CFD plus the CFE is called the CCF (see Table 8.29). With this CCF, we can calculate the value of the firm.

$$\text{CCF} = \text{CFD} + \text{CFE}, \tag{8.11}$$

$$\text{CCF} \equiv \text{What the owners of debt and equity receive.} \tag{8.12}$$

Table 8.29 Calculation of the CCF

Year	6	7	8	9	10
CFD	10.6	9.7	−12.6	13.0	12.1
CFE	17.2	23.0	26.2	29.4	30.2
CCF	27.7	32.8	13.6	42.3	42.3

CFD cash flow to debt, *CFE* cash flow to equity, *CCF* capital cash flow

8.12.4 The Free Cash Flow

$$\text{FCF} \equiv \text{What the owners of debt and equity receive minus the tax savings.} \quad (8.13a)$$

Hence, a simple way to derive the FCF is using (8.10d)

$$\text{FCF} = \text{CFD} + \text{CFE} - \text{TS}. \quad (8.13b)$$

All the variables have been already defined.

Observe that FCF is related to the other three cash flows: the CFD, CFE, and TS.

As can be seen, this is the easiest way to construct the FCF: the direct method. The CFD and the CFE can be obtained from the CB. It can be shown that if EBIT (plus other income) is greater than interest charges, the TS will be T $\times$ interest. If EBIT is positive but lower than interest charges, the TS is T $\times$ EBIT. If EBIT is negative, the TS is zero.[14] Table 8.30 presents the calculation of tax shield.

From the IS and input data we have, for instance, the TS for year 8 is 35.5% $\times$ 3.5 = 1.2.

In a previous table, we have calculated the CFD, the CFE, and the CCF. Hence, the FCF can be calculated as follows:

$$\text{FCF} = \text{CCF} - \text{TS} = \text{CFD} + \text{CFE} - \text{TS}. \quad (8.14)$$

This is demonstrated in Table 8.31.

The FCF for year 9 is 42.3 – 2.0 = 40.3. We have just learned how to derive the cash flows (specially the FCF) with the direct method. In the next section, we show how to calculate the FCF using the indirect method.

8.12.5 Indirect Methods

Now we proceed to illustrate the use of the most popular approach to calculate the FCF: the indirect method. In the indirect method, the analyst only has available the traditional financial statements: the IS and the BS.

[14] If we have losses carried forward (LCF), we can recover in future periods the TS not earned. In any case, we have to check the tax law.

Table 8.30 Calculation of tax saving (TS)

Year	6	7	8	9	10
Earnings before interest and taxes (EBIT)	52.7	58.4	64.3	70.0	77.5
Interest payments	5.1	4.2	3.5	3.8	3.2
Return (interest) from short-term (ST) investment	1.9	2.2	2.3	0.0	0.2
Earnings before taxes (EBT)	49.5	56.5	63.1	66.2	74.5
Tax rate	35.0%	35.0%	35.0%	35.0%	35.0%
TS = T × interest	1.8	1.5	1.2	1.5	1.3

Table 8.31 Calculation of the FCF using the direct method

Year	6	7	8	9	10
CFD	10.6	9.7	−12.6	13.0	12.1
CFE	17.2	23.0	26.2	29.4	30.2
CCF	27.7	32.8	13.6	42.3	42.3
TS	1.9	1.6	1.3	2.0	1.7
FCF	25.9	31.2	12.3	40.3	40.7

CFD cash flow to debt, *CFE* cash flow to equity, *CCF* capital cash flow, *TS* tax saving, *FCF* free cash flow

In this situation, it is necessary to calculate the amount of investment in operating assets. This calculation follows:

$$\begin{aligned} \text{Net fixed Assets}_t &= \text{Net fixed Assets}_{t-1} + \text{Investment in operating assets}_t \\ &\quad - \text{Depreciation}_t, \qquad (8.15a) \\ \text{Investment in operating assets}_t &= \text{Net fixed Assets}_{\text{t}} - \text{Net fixed Assets}_{t-1} \\ &\quad + \text{Depreciation}_t. \qquad (8.15b) \end{aligned}$$

The most popular approach to calculate the FCF also requires the calculation of the working capital of the firm (current assets minus current liabilities) and changes in working capital (CWC) from one period to the next and introduces that amount in the following equation:

$$\begin{aligned} \text{FCF} = \text{EBIT} \times (1 - \text{T}) + \text{Depreciation} + \text{Amortization} - \text{CWC} \\ - \text{Investment in operating assets}^{15} \qquad (8.16) \end{aligned}$$

Where EBIT is earning before taxes and interest, T is the corporate tax rate, and CWC is the change in working capital. What we do with this formula is to undo some transactions in the IS based on accrual and cost apportioning into a cash flow.

[15] We can also calculate the FCF from the net income.

8.12.5.1 A Closer Look at the Change in Working Capital

While calculating EBIT $\times$ $(1–T)$, we are recognizing corporate taxes without the effect of tax savings for payment of interest. This is taken into account in the discount rate – the weighted average cost of capital. When we add back depreciation and amortization, we recognize that they are not a cash flow (remember that we are trying to convert accounting items (with accrual) into cash flows. When we subtract the CWC, we are adjusting the accounting result (EBIT) that is based on the accrual principle[16] with those items that appear in the IS, but that in terms of cash flow have not yet occurred (say, sales and COGS because there exist AR and AP).

Let us examine in detail the arithmetic operations with the CWC and in particular an item that will allow us to understand why it has to be subtracted (See Velez-Pareja 2005).[17] The sales generated in any year might not result in an equal amount in cash because the firm might sell goods on credit. In order to estimate the amount of cash received from sales the AR have to be subtracted.

That is, the firm receives

$$\text{CF due to sales at } t = \text{CF}_{\text{St}} = \text{Sales}_t - \text{AR}_t \tag{8.17a}$$

Second, at the beginning of year t (end of year $t–1$) there were some AR pending to be received, and were invoiced at year $t–1$, this is AR_{t-1}. If those AR were received in t, then they will be part of the cash flow of t. If not, they will be listed in AR_t. Hence, the total cash flow in t due to sales in t and years before will be

$$\text{CF}_{\text{St}} = \text{AR}_{t-1} + \text{Sales}_t - \text{AR}_t \tag{8.17b}$$

Grouping terms we have

$$\text{CF}_{\text{St}} = \text{Sales}_t + \text{AR}_{t-1} - \text{AR}_t \tag{8.17c}$$

or,

$$\text{CF}_{\text{St}} = \text{Sales}_t - (\text{AR}_t - \text{AR}_{t-1}) \tag{8.17d}$$

That is, we subtract the change in AR from $t-1$ to t, from sales_t to arrive at cash received from current and previous sales. Remember that AR are part of the working capital.

Similar logic holds good for AP. Part of the purchases would not have been paid yet and hence the cash flow due to the purchases in year t, P_t, is

$$\text{CF from Purchases in } t = P_t - \text{AP}_t \tag{8.18a}$$

where AP_t means accounts payable in year t.

---

[16] To make the analysis easier and without loss of generality, we are assuming no excess cash investment in short-term securities and no cash in hand.

[17] The following paragraphs and equations are taken from there.

As with AR, we would have some AP from previous years. The cash flow for year t is

$$\mathrm{CF}_{\mathrm{Pt}} = \mathrm{AP}_{t-1} + P_t - \mathrm{AP}_t \tag{8.18b}$$

Grouping terms we have

$$\mathrm{CF}_{\mathrm{Pt}} = P_t - (\mathrm{AP}_t - \mathrm{AP}_{t-1}) \tag{8.18c}$$

COGS can be written as follows:

$$\mathrm{COGS}_t = \mathrm{FI}_{t-1} + P_t - \mathrm{FI}_t \tag{8.19a}$$

where FI is final inventory and COGS is the cost of goods sold.

From (8.19a), we solve for P_t and replace it in (8.18c)

$$P_t = \mathrm{COGS}_t + \mathrm{FI}_t - \mathrm{FI}_{t-1} \tag{8.19b}$$

The cash flow associated to COGS is

$$\mathrm{CF}_{\mathrm{P}_t} = \mathrm{COGS}_t + \mathrm{FI}_t - \mathrm{FI}_{t-1} - (\mathrm{AP}_t - \mathrm{AP}_{t-1}) \tag{8.20}$$

Then the net CF is

$$\text{Net CF}_t = \text{Sales}_t - (\mathrm{AR}_t - \mathrm{AR}_{t-1}) - (\mathrm{COGS}_t + \mathrm{FI}_t - \mathrm{FI}_{t-1} - (\mathrm{AP}_t - \mathrm{AP}_{t-1})) \tag{8.21a}$$

Simplifying we have

$$\text{Net CF}_t = \text{Sales}_t - \mathrm{COGS}_t - (\mathrm{AR}_t - \mathrm{AR}_{t-1}) - (\mathrm{FI}_t - \mathrm{FI}_{t-1}) + (\mathrm{AP}_t - \mathrm{AP}_{t-1}) \tag{8.21b}$$

Simplifying

$$\text{Net CF}_t = \mathrm{EBIT}_t - \mathrm{CWC}_t \tag{8.21c}$$

To convert EBIT into a cash flow, we have to subtract the change in working capital.

8.12.5.2 An Apparent Paradox

Now we are confronted with an apparent paradox: the FCF is supposed to be free of the effects of financing and yet we have calculated the FCF from the items that finance the firm (as we did in the first method). The answer is, we can think of it as what the owners of the capital receive (first or direct method) or what is available for distribution (indirect method) and is distributed the owners of capital (debt and equity) after adjusting for tax savings. Both approaches arrive to the same result.

This idea is presented graphically below:

Where do we get each piece of information to derive the cash flows? Cash flows are derived from the CB under the direct method (and from the knowledge of the

Direct method		Indirect method
FCF = CFD + CFE − TS →	What is available and distributed to the debt and equity holders adjusted by the tax savings?	FCF = EBIT × (1 − T) ← + Depreciation + Amortization − CWC − Investment in operating assets

way taxes are paid and if EBIT is greater, equal, or lower than the interest charges). In the indirect method, we take the information from the BS and the IS.

In the following sections, we illustrate the calculation of FCF using the indirect method.

8.12.5.3 Cash Flows from the Income Statement

The indirect method uses the information from the IS and the BS to derive cash flows. In Table 8.32, we calculate the working capital and its change.

The investment in assets is to be derived from the pro forma financial statements. The calculation of investment in operating assets is presented in Table 8.33 [using (8.14b)].

The investment in year 8 is 107.2–42.2 + 22.0 = 87.0. This amount includes depreciation for year 8 (as an investment) and the purchase of the new asset of 67 forecasted for that year.

The derivation of the FCF and the CFE is shown in Tables 8.34 and 8.35, respectively.

Table 8.32 Working capital and change in working capital

Year	5	6	7	8	9	10
Working capital						
Cash	14.0	15.0	16.1	17.3	18.7	20.3
Accounts receivable	15.5	29.0	31.2	33.5	36.2	39.2
Inventory	30.3	23.1	24.8	26.4	28.5	30.7
Marketable securities	31.1	42.2	49.1	0.0	4.6	12.9
Current assets	90.9	109.3	121.3	77.2	88.1	103.1
Accounts payable	28.8	36.1	39.6	42.2	45.5	49.0
Current liabilities	28.8	36.1	39.6	42.2	45.5	49.0
Working capital = current assets – current liabilities + short-term debt	62.0	73.2	81.7	35.0	42.6	54.1
Change in working capital		11.2	8.4	−46.7	7.6	11.5

Table 8.33 Calculation of the investment in fixed assets from the financial statements

Year	5	6	7	8	9	10
Net fixed assets	42.2	42.2	42.2	107.2	107.2	107.2
Depreciation		14.1	17.6	22.0	29.7	37.1
Investment in operating assets$_t$ = net fixed assets$_t$ − net fixed assets$_{t-1}$ + depreciation$_t$		14.1	17.6	87.0	29.7	37.1

Table 8.34 Free cash flow (FCF) derived from earning before interest and taxes (EBIT)

Year	6	7	8	9	10
EBIT	52.7	58.4	64.3	70.0	77.5
Minus tax on EBIT	−18.5	−20.5	−22.5	−24.5	−27.1
Plus depreciation and amortization	14.1	17.6	22.0	29.7	37.1
Plus return on (short-term) ST investments	1.9	2.2	2.3	0.0	0.2
Minus tax on return on ST investment	−0.7	−0.8	−0.8	0.0	−0.1
Minus change in working capital	−11.2	−8.4	46.7	−7.6	−11.5
Minus investments in operating assets	−14.1	−17.6	−87.0	−29.7	−37.1
FCF	24.3	31.0	24.9	37.9	39.0

Table 8.35 Cash flow to equity (CFE) derived from earnings before interest and taxes (EBIT)

Year	6	7	8	9	10
EBIT	52.7	58.4	64.3	70.0	77.5
Minus tax on EBIT	−18.5	−20.5	−22.5	−24.5	−27.1
Plus depreciation and amortization	14.1	17.6	22.0	29.7	37.1
Minus change in working capital	−11.2	−8.4	46.7	−7.6	−11.5
Minus principal payments	−5.2	−5.2	3.6	−6.0	−6.0
Minus investments in operating assets	−14.1	−17.6	−87.0	−29.7	−37.1
Plus return on (short-term) ST investments	1.9	2.2	2.3	0.0	0.2
Minus tax on return on ST investment	−0.7	−0.8	−0.8	0.0	−0.1
Minus interest payments	−5.1	−4.2	−3.5	−3.8	−3.2
Plus tax savings	1.8	1.5	1.2	1.3	1.1
CFE	15.8	23.1	26.3	29.4	30.9

CFE is derived from EBIT. In this case, we need to calculate the tax shield as we did in the direct method.

We can derive FCF from net income as well. This is demonstrated in Table 8.36.

Similarly, CFE can be estimated from net income. In this case, we do not need to calculate tax shields, however. This is demonstrated in Table 8.37.

Table 8.36 Free cash flow (FCF) from net income

Year	6	7	8	9	10
Net income	32.2	36.7	41.0	43.0	48.4
Plus depreciation and amortization	14.1	17.6	22.0	29.7	37.1
Plus interest payments	5.1	4.2	3.5	3.8	3.2
Minus tax savings	−1.8	−1.5	−1.2	−1.3	−1.1
Minus change in working capital	−11.2	−8.4	46.7	−7.6	−11.5
Minus investments in operating assets	−14.1	−17.6	−87.0	−29.7	−37.1
FCF	24.3	31.0	24.9	37.9	39.0

Table 8.37 Cash flow to equity (CFE) from net income

Year	6	7	8	9	10
Net income	32.2	36.7	41.0	43.0	48.4
Plus depreciation and amortization	14.1	17.6	22.0	29.7	37.1
Minus change in working capital	−11.2	−8.4	46.7	−7.6	−11.5
Minus principal payments	−5.2	−5.2	3.6	−6.0	−6.0
Minus investments in operating assets	−14.1	−17.6	−87.0	−29.7	−37.1
CFE	15.8	23.1	26.3	29.4	30.9

Both the approaches arrive at the same result. But the second method is more complex and prone to errors. The usual argument is that in the first method we need an additional financial statement and that with the indirect method we require less information.

This type of financial modeling is especially useful for nontraded firms. Traded firms can observe their value everyday. Nontraded firms cannot. This type of analysis needs not be a one time exercise at the time of an acquisition or divestiture or capital budgeting. This should be a permanent managerial tool to assess the value of the firm. Further, this can be used to perform sensitivity analysis of a firm's actions.

8.12.5.4 How the "Recipe" Works?

Many users of the previous textbook formulas for deriving the cash flows from the IS and the BS use the procedure as a recipe without fully understanding it. FCF is estimated as follows:

EBIT
Minus tax on EBIT
Plus depreciation and amortization
Plus return on ST investments
Minus tax on return on ST investment
Minus change in working capital
Minus investments in operating assets
= FCF

The reasons for including each item in the previous "formula" are discussed below.

- Taxes are calculated because our analysis includes taxes. Taxes on EBIT are hypothetical taxes, not actual because we have not deducted interest payment.
- Adjustments for noncash and investment in operating assets are to be made because they would affect cash flow but not the IS.
- After tax return on ST investment is added because it will be eventually received by equity holders.

Free CFE is estimated as follows:

Net Income
Plus depreciation
Minus change in working capital
Minus principal payments
Minus investments in operating assets
= CFE

- The reasons for including depreciation, amortization, CWC, and investment in operating assets have been explained above.
- Interest payments are accounted for in net income whereas principal repayments are subtracted separately because these are debt cash flows that the firm must pay.

8.13 Summary

In this chapter, we presented a methodology for forecasting financial statements and the derivation of cash flows. We presented two alternate approaches – the direct and the indirect method. We illustrated the two approaches through an example. The chapter on valuation models refines some of the ideas presented here.

Appendix A: A Summary of the Chapter

1. The analyst should gather from the firm, the following information:

   a. Historical financial statements
      i. To calculate indexes such as gross margin, operational margin, or net margin. This will be useful to double-check if deviations from the historical average are substantial.
      ii. To calculate the indexes that reveal policies of the firm like
         1. Accounts receivable
         2. Accounts payable
         3. Inventories
         4. Payment of dividends

5. Investment in fixed assets
6. Investment of cash excesses
7. Cash required by operations held by the firm

b. Information about quantities, prices, product mix, changes in the amount of fixed costs due to changes in the level of operations and the like. This information allows the analyst to
   i. Calculate price increases
   ii. Calculate real growth of units sold
   iii. Analyze the behavior of some of these items and to explain any unusual behavior (i.e., very high or very low growths rates). For instance, we might examine the behavior of items such as
   1. Amount of sales revenues
   2. Labor expenses
   3. Overhead expenses
   4. Cost of goods sold
   5. After we analyze these items, we can compare growth with historical inflation rates and try to explain what happened. For instance, if the firm shows a growth in sales revenues of 102% and inflation rate was 5%, we have to find out the causes of the other $92.38\%((1+102\%)/(1+5\%)-1 = 92.38\%)$.

2. The analyst should keep in mind some ideas:

   a. The growth in some items has three components. For instance, the growth in sales revenues comprises inflation rate, real growth (in units), and a real increase in prices.
   b. Some variables are a measure of activity. Hence, their growth is just that: an increase in volume, in units. For instance, the growth in the number of people attending a theater. This is different from the growth in sales revenues in dollars that includes inflation, increase in units, and real increase in prices.

3. The analyst should gather some initial information such as

   a. Initial amount of some items such as overhead expenses, labor costs, and the like.
   b. Accounts receivable, accounts payable, debt balances (find out how is the schedule of repayment of those debt balances).

4. Information that usually is not found in the historical financial statements.

   i. Historical selling prices of products/services not sold by the firm
   ii. Historical price of inputs
   iii. Historical inflation rate
   iv. Historical minimum wage
   v. With these data, we can estimate the real increase in selling and purchasing prices. In some countries, the increase in salary is determined by the increase in the minimum wage increase. On the basis of this information, we can estimate the real increase in prices and combine them with the expected inflation

to estimate the nominal increase in prices. The estimates for some variables are available with the Central Bank.

vi. Interest rates charged by the bank. However, in the body of the chapter we have shown an approach to estimate rates from the financial statements.

5. Gather data on sales forecasts, ST, and LT budgets.
6. Keep this in mind while dealing with firms with multiple products:

   a. Group products that use the same raw material. We can identify a common raw material or unit of measure to estimate their sales revenues: gallons of beer or soft drinks, juices, tons of paper, feet of lumber or wood, tons of bronze, hours invoiced, minutes or seconds invoiced, and so on. Based on the sales revenues and cost of sales from an IS estimate the selling price or the cost per unit. All this depends on the availability of information in the firm.
   b. Use Pareto's law: 20% of the causes are responsible for 80% of the effects. Twenty percent of the products of the firm are responsible of 80% of the cost or the sales revenues.
   c. Identify products and/or services with largest volume of sales. Measure its growth and/or the increase in prices. Use this as a proxy for the growth in units for the whole firm or the real price increase.

7. Identify the "driver" of the demand of the product or service. For instance, if the firm manufactures clothes for babies, the growth of the units sold will be associated with the population of 0–3 olds. If the firm manufactures wooden doors for housing, the growth would be determined by the growth of construction industry.
8. Avoid the use of plugs. The plug is a formula that calculates the difference between total liabilities and equity minus all the lines in the BS except cash.
9. With all this information, we can construct consistent and flexible financial statements.
10. Once we have constructed the financial statements, we can proceed to calculate cash flows for valuation purposes.

Appendix B: Example for Estimating Nominal and Real Rates

1. Gather historical series of

   1.1. Prices of inputs and products of the company or of similar products
   1.2. Different typical expenses of the company or from similar companies (general expenses, rent, wages, etc.)
   1.3. Risk-free interest rates
   1.4. Inflation rate of and
   1.5. Interest rates charged by the banks.

   Assume that we have the historical value of minimum wage and inflation rates for the last 10 years (shown in Table B1).

Table B1 Minimum wage and inflation

Year	Minimum wage[18]	Inflation rate (%)
1996	142,125	21.64
1997	172,005	17.68
1998	203,826	16.70
1999	236,460	9.23
2000	260,100	8.75
2001	286,000	7.64
2002	309,000	6.99
2003	332,000	6.49
2004	358,000	5.50
2005	381,500	4.85

2. Calculate the nominal rates of increase of prices. The nominal increase in minimum wages can be calculated as follows:

Table B2 Minimum wage and nominal increase

Year	Minimum wage	Nominal increase (%)
1996	142,125	
1997	172,005	21.02
1998	203,826	18.50
1999	236,460	16.01
2000	260,100	10.00
2001	286,000	9.96
2002	309,000	8.04
2003	332,000	7.44
2004	358,000	7.83
2005	381,500	6.56

To calculate the nominal increase, we use the following formulation:

$$\text{Nominal increase}_t = \frac{\text{Wage}_t}{\text{Wage}_{t-1}} - 1.$$

For year 2005

$$\text{Nominal increase} = \frac{381,500}{358,000} - 1 = 6.56\%.$$

3. Calculate

3.1. Real rates of increase in prices (deflating the nominal rates)
3.2. Real rates of interest (deflating the risk-free rate of interest)

[18] I have used the data for Colombia.

3.3. Average the real rates and use that average as input for the forecast
3.4. Calculate the risk premium banks charge customers (K_d) as the difference between historical Kd and the historical risk-free rates. Average these results and use the average for the forecast.

In Our example, as we know the nominal increase and the inflation rate, we can calculate the real increase as follows.

$$\text{Real increase} = \frac{1 + \text{nominal increase}}{1 + \text{inflation rate}} - 1.$$

For instance, for year 2005, we have

$$\text{Real increase} = \frac{1 + 6.56\%}{1 + 4.85\%} - 1 = 1.63\%.$$

In the case of the minimum wage, we have

Table B3 Nominal and real increases

Year	Nominal increase (%)	Real increase (%)
1996		
1997	21.02	2.84
1998	18.50	1.54
1999	16.01	6.21
2000	10.00	1.15
2001	9.96	2.15
2002	8.04	0.98
2003	7.44	0.90
2004	7.83	2.21
2005	6.56	1.63

The average of the real increase since 1997 is 2.18% and this value might be used in the forecast as the real increase.

4. Find a reliable forecast for inflation.
   Assume the following inflation forecast:

Table B4 Forecasted inflation

Year	Forecasted inflation (%)
2006	4.50
2007	4.00
2008	3.50
2009	3.00
2010	3.00
2011	3.00
2012	3.00

5. With the real rates and the inflation forecast
   5.1. Calculate Nominal rates
   5.2. Calculate risk-free rates
   5.3. With the forecasted risk-free rate use CAPM to find the forecasted K_d.

   The calculation of nominal increase in minimum wage increase is shown in Table B5.

Table B5 Forecasted nominal increase in minimum wage

Year	Forecasted inflation (%)	Real increase in wages (%)	Nominal increase (%)
2006	4.50	2.18	6.78
2007	4.00	2.18	6.27
2008	3.50	2.18	5.76
2009	3.00	2.18	5.24
2010	3.00	2.18	5.24
2011	3.00	2.18	5.24
2012	3.00	2.18	5.24

   We can construct the nominal increase using Fisher equation:
   Nominal increase = (1 + inflation rate) × (1+ real increase) −1.
   For year 2012,
   Nominal increase $= (1+3.00\%) \times (1+2.18\%) - 1 = 5.24\%$.
6. Apply the nominal increases to the values that you have found for today (purchase and sale prices, general expenses, etc.).
   This is shown in Table B6.
   The minimum wage for 2006 $= 381,500.00 \times (1+6.78\%) = 407,354.79$.

Table B6 Forecasted minimum wage

Year	Nominal increase in wages (%)	Value of the minimum wage
2006	6.78	407,354.79
2007	6.27	432,880.65
2008	5.76	457,794.44
2009	5.24	481,803.27
2010	5.24	507,071.22
2011	5.24	533,664.35
2012	5.24	561,652.13
2013	6.78	591,107.72

7. Estimate the real growth rate of your products or services (in units). In order to evaluate if it is reasonable, compare it with the real growth rate of the economy or the industry where the company or project is located. Another benchmark to check this increase in volume is the growth rate of the driver of the demand. For instance, the population between some given ages, the forecasted growth or the

relevant industry associated with the product or service that we plan to sell, and so on.

8. With the rate of real increase (rate of increase in volume or units of product or service), forecast the units to sell in the future.
9. After these steps, you must have nominal increases in prices and expenses, nominal risk-free rates and risky interest rates, volumes of sales in units, forecasted inflation.

Appendix C: Example of Using the GDP Implicit Deflator

1. Find historical series for

1.1. Sales revenues and costs for the firm or for a similar firm
1.2. GDP at nominal and real prices or directly the series for the implicit deflator
1.3. Producer price index (PPI) or its change

Assume that we identify the sales revenues for the firm, the nominal, and real GDP:

Table C1 Nominal and constant (real) dollar GDP and sales revenues

Year	$GDP_{nominal}$	GDP_{real}	Sales Revenues
1980	2,789.5	5,161.7	25,674.0
1981	3,128.4	5,291.7	28,526.9
1982	3,255.0	5,189.3	30,980.4
1983	3,536.7	5,423.8	32,827.1
1984	3,933.2	5,813.6	34,715.5
1985	4,220.3	6,053.7	36,553.9
1986	4,462.8	6,263.6	38,131.1
1987	4,739.5	6,475.1	39,989.8
1988	5,103.8	6,742.7	42,303.2
1989	5,484.4	6,981.4	44,946.3
1990	5,803.1	7,112.5	47,408.4
1991	5,995.9	7,100.5	49,955.0
1992	6,337.7	7,336.6	51,933.7
1993	6,657.4	7,532.7	54,227.5
1994	7,072.2	7,835.5	56,527.6
1995	7,397.7	8,031.7	58,837.4
1996	7,816.9	8,328.9	60,871.5
1997	8,304.3	8,703.5	63,257.2
1998	8,747.0	9,066.9	65,405.5
1999	9,268.4	9,470.3	67,605.0
2000	9,817.0	9,817.0	70,037.6
2001	10,100.8	9,866.6	72,964.4
2002	10,480.8	10,083.0	75,530.4
2003	10,983.9	10,397.2	77,833.6

2. Using the previous table, we calculate the deflator for the GDP and the inflation rate (increase in nominal prices) measured by the deflator.
   Table C2. Inflation, sales revenues and nominal increase in sales revenues

Table C2 Inflation, sales revenues and nominal increase in sales revenues

Year	GDP nominal	GDP real	Deflator	Inflation (%)	Sales revenues	Increase in sales revenues (%)
1980	2,789.5	5,161.7	0.5404		25,674.0	
1981	3,128.4	5,291.7	0.5912	9.39	28,526.9	11.11
1982	3,255.0	5,189.3	0.6273	6.10	30,980.4	8.60
1983	3,536.7	5,423.8	0.6521	3.96	32,827.1	5.96
1984	3,933.2	5,813.6	0.6766	3.75	34,715.5	5.75
1985	4,220.3	6,053.7	0.6971	3.04	36,553.9	5.30
1986	4,462.8	6,263.6	0.7125	2.20	38,131.1	4.31
1987	4,739.5	6,475.1	0.7320	2.73	39,989.8	4.87
1988	5,103.8	6,742.7	0.7569	3.41	42,303.2	5.79
1989	5,484.4	6,981.4	0.7856	3.78	44,946.3	6.25
1990	5,803.1	7,112.5	0.8159	3.86	47,408.4	5.48
1991	5,995.9	7,100.5	0.8444	3.50	49,955.0	5.37
1992	6,337.7	7,336.6	0.8638	2.30	51,933.7	3.96
1993	6,657.4	7,532.7	0.8838	2.31	54,227.5	4.42
1994	7,072.2	7,835.5	0.9026	2.13	56,527.6	4.24
1995	7,397.7	8,031.7	0.9211	2.05	58,837.4	4.09
1996	7,816.9	8,328.9	0.9385	1.90	60,871.5	3.46
1997	8,304.3	8,703.5	0.9541	1.66	63,257.2	3.92
1998	8,747.0	9,066.9	0.9647	1.11	65,405.5	3.40
1999	9,268.4	9,470.3	0.9787	1.45	67,605.0	3.36
2000	9,817.0	9,817.0	1.0000	2.18	70,037.6	3.60
2001	10,100.8	9,866.6	1.0237	2.37	72,964.4	4.18
2002	10,480.8	10,083.0	1.0395	1.54	75,530.4	3.52
2003	10983.9	10,397.2	1.0564	1.63	77,833.6	3.05

To calculate the deflator, we use the following relation:

$$\text{Deflator}_t = \frac{G\text{DP nominal}_t}{G\text{DP real}_{t-1}}.$$

For year 2003

$$\text{Deflator}_{2003} = \frac{10,983.9}{10,397.2} = 1.0564.$$

To calculate the inflation using the deflator, we use the following expression:

$$\text{Inflation}_t = \frac{\text{Deflator}_t}{\text{Deflator}_{t-1}} - 1.$$

For year 2003

$$\text{Inflation}_{2003} = \frac{1.0564}{1.0395} - 1 = 1.63\%.$$

To calculate the increase in sales revenues, we use

$$\text{Increase in sales revenues}_t = \frac{\text{Sales revenues}_t}{\text{Sales revenues}_{t-1}} - 1.$$

For 2003

$$\text{Increase in sales revenues}_{2003} = \frac{77{,}833.6}{75{,}530.6} - 1 = 3.05\%.$$

3. With the increase in sales revenues and the change in the deflator, we can calculate an estimate for the "real" growth of the industry to be used as the growth for the firm. We say "real" growth because that growth has in it the real increase in prices.

Table C3 "Real" growth calculation

Year	Inflation (deflator) (%)	Increase in sales revenues (%)	"Real" growth = (1 + increase in sales revenues)/(1 + inflation) − 1 (%)
1980			
1981	9.39	11.11	1.6
1982	6.10	8.60	2.4
1983	3.96	5.96	1.9
1984	3.75	5.75	1.9
1985	3.04	5.30	2.2
1986	2.20	4.31	2.1
1987	2.73	4.87	2.1
1988	3.41	5.79	2.3
1989	3.78	6.25	2.4
1990	3.86	5.48	1.6
1991	3.50	5.37	1.8
1992	2.30	3.96	1.6
1993	2.31	4.42	2.1
1994	2.13	4.24	2.1
1995	2.05	4.09	2.0
1996	1.90	3.46	1.5
1997	1.66	3.92	2.2
1998	1.11	3.40	2.3
1999	1.45	3.36	1.9
2000	2.18	3.60	1.4
2001	2.37	4.18	1.8
2002	1.54	3.52	2.0
2003	1.63	3.05	1.4

To estimate the real growth, we use

$$\text{"Real" growth}_t = \frac{1 + \text{increase in sales revenues}}{1 + \text{inflation}} - 1$$

For instance, for 2003 we have

$$\text{“Real” growth}_t = \frac{1+0.0305}{1+0.0163} - 1 = 1.4\%.$$

Calculate the average of these growth rates. In this example, it is 1.9%. Use this average as the forecast.

Table C4 Forecasted inflation

Year	Inflation (%)
2004	1.04
2005	0.97
2006	0.90
2007	0.83
2008	0.77

4. Forecast the inflation for the deflator for future years.
5. Now we have enough information to forecast the sales revenues: future inflation, estimated real growth that is composed by the growth in units and the real increase in prices. When we combine these two inputs we can calculate the increase in sales revenues and we apply it to the last historical sales revenues for 2003.
   Increase in sales revenues$_t$ $= (1+\text{ inflation}_t) \times (1+\text{ real growth}_t) - 1$

Table C5 Forecasted nominal increase in sales and sales levels

Year	Inflation PPI (%)	Real growth (%)	Increase in sales revenues (%)	Sales revenues
2003				77,833.6
2004	1.04	1.9	2.99	80,161.7
2005	0.97	1.9	2.92	82,500.2
2006	0.90	1.9	2.85	84,848.2
2007	0.83	1.9	2.78	87,204.8
2008	0.77	1.9	2.71	89,569.0

In a similar fashion, we could use the inflation estimate from the PPI or the CPI. The advantage in using this procedure is that we do not use an increase in sales revenues based on the historical increases. For instance, in this case the average increase in sales revenues was 5.0%. This estimate is not consistent with the inflation perspectives and would overstate the increase in sales revenues for years 2004–2008. Besides, the procedure allows us to perform an enriched sensitivity analysis.

It is to be understood that the real growth is a mixture of real increase in prices and growth in units. The relationship between these two components is not additive but multiplicative, as follows:

$$\text{Real growth} = (1 + \text{Increase in volume}) \times (1 + \text{Increase in real prices}) - 1$$

Knowing this relationship we could explore several combinations of increase in volume and/or increase in real prices. The combination of these two variables should always give the 1.9% on the average. For instance,

Table C6 Splitting the "real" growth between real increase in price and growth in units

Growth in units (g) (%)	Real increase in prices (Rrp) (%)	"Real" growth (%)
0.00	1.90	1.90
0.25	1.65	1.90
0.50	1.39	1.90
0.75	1.14	1.90
1.00	0.89	1.90
1.25	0.64	1.90
1.50	0.39	1.90
1.75	0.15	1.90
2.00	−0.10	1.90

Now we have a wide range of values for g or Rrp to choose from. One way to pick a proper value is to compare growth in units with the industry GDP growth or any other real measure of growth.

Appendix D: An Example of Plugs and Their Problems

In the following tables, we show a simple example of how the "plug" is calculated. In the first table, we show a simplified IS and a BS. In the subsequent tables, we also show how using arbitrary values for items other than the plug we keep the keep the BS balanced.

Table D1 Income statement and balance sheet using ST debt as plug

Month	0	1
EBIT		5.0
Return (interest) from ST investment		0.0
Interest payments		2.6

(continued)

Table D1 (continued)

Month	0	1
Net income		2.4
Cumulated retained earnings		2.4
Month	0	1
Assets		
Cash	0.0	0.0
ST investments		
Total fixed assets	45.0	36.0
Total	45.0	36.0
Liabilities and equity		
ST debt PLUG	0.000	−7.400
LT debt	20.0	16.0
Equity investment	25.0	25.0
Retained earnings	0.0	2.4
Total liabilities and equity	45.00	36.00
Check	0.0	0.0

In the BS, we have ST debt as the plug as follows:

$$\text{ST debt} = \text{Total assets} - \text{LT debt} - \text{Equity investment} - \text{Retained earnings}. \quad \text{(D1)}$$

If we arbitrarily change *any* number from the right-hand side of (D1), the balancing is maintained. This means that the analyst could make any mistake and the balance sheet still balances.

In the next table, we show this for two results: one is the value of the plug itself and the other is for the checking of the balance sheet. In panel A, we have the value of the plug. We *arbitrarily* change cash and total fixed assets. As can be seen the balancing is maintained. In panel B, we *arbitrarily* change retained earnings, Cash, dividends payments and equity. The same: the checking of the balancing is kept.

Table D2 Using items from the BS

Panel A				Panel B			
ST debt		*Cash*		Check balance		*Retained earnings*	
		5	20			5	50
Total fixed assets	20	−18.4	−3.4	*Cash*	5	0	0
	50	11.6	26.6		50	0	0
Check balance		*Cash*		Check balance		*Dividends payment*	
		5	50			5	50
	20	0	0		5	0	0
Total fixed assets	50	0	0	*Equity*	50	0	0

The danger of using plugs is that we could even make *accounting mistakes* and the model will not identify that the mistake.

Suppose we *arbitrarily* select cash as 5 and total fixed assets as 20. The financial statements would be

Table D3 Matching of the financial statements with plug

Month	0	1
EBIT		5.0
Return (interest) from ST investment		0.0
Interest payments		2.6
Net income		2.4
Cumulated retained earnings		2.4
Month	0	1
Assets		
Cash	0.0	5.0
ST investments		
Total fixed assets	45.0	20.0
Total	45.0	25.0
Liabilities and equity		
ST debt PLUG	0.000	−18.400
LT debt	20.0	16.0
Equity investment	25.0	25.0
Retained earnings	0.0	2.4
Total liabilities and equity	45.00	25.00
Check	0.0	0.0

Notice that we have changed total assets (cash = 5 and fixed assets = 20) and hence the plug shows that balancing is correct.

Observe that using plugs the analyst lose control over what is happening in the model. For instance, when we arbitrarily changed the level of cash, the model, to keep the balancing, changed the amount of ST debt, and converted it to a higher ST investment (a more negative debt)! The IS for year 1 does not change because decisions made in year 1 (regarding debt, for instance), will affect the IS for year 2.

What happens if we have a negative debt? We can think that negative debt is investment. Will the firm receive a return equal to the cost of debt? As the interest charges in the following month will be negative, will this mean an income? To avoid these inconsistencies, the model needs some logical statements in the spreadsheet.

In the previous tables, we *arbitrarily* changed items from the BS itself. Now we can see that even changing items in the IS we keep celebrating the balancing of the BS. In this case we *arbitrarily* change interest payments, return on ST investment, net income and retained earnings.

Table D4 Using items from the IS

Check balance		*Interest payments*	
		5	50
Return from ST investment	5	0	0
	50	0	0
Check balance		*Net income*	
		5	50
Retained earnings	5	0	0
	50	0	0

A conclusion from this simple example is that you can even make ANY mistake and you will never realize.

Appendix E: Constructing the Financial Model

In this appendix, we present a guide to construct the model used in the body of the chapter. We indicate the formulas that have to be utilized in the construction of the financial model. We have constructed the formulas in such a way that they can be used to construct either a part of or the complete model.

Table E1 shows the input data.

In this section, we show intermediate tables that are required to construct the financial statements.

This table shows the forecast for the cash budget

In the next table, we show the forecast for the IS

Finally we show the balance sheet in the next table

Table E1 Input data

	B	J	K	L	M	N
7		6	7	8	9	10
8	Corporate tax rate.	35.0%	35.0%	35.0%	35.0%	35.0%
9	Initial inventory (units)					
10	Initial purchase price					
11	Estimated overhead expenses					
12	Administrative and sales payroll					
13	LT years loan 1 at (5 years)					
14	LT years loan 3 (10 years)					
15	ST loan 2 (1 year)					
16	Taxes are paid the same year as accrued					
17	Inflation rate	4.0%	3.5%	3.0%	3.0%	3.0%
18	Real increase in selling price	1.03%	1.03%	1.03%	1.03%	1.03%
19	Real increase in purchase price	0.55%	0.55%	0.55%	0.55%	0.55%
20	Real increase in overhead expenses	0.85%	0.85%	0.85%	0.85%	0.85%
21	Real increase in payroll expenses	1.91%	1.91%	1.91%	1.91%	1.91%
22						
23	Increase in sales volume (units)	3.0%	3.0%	3.0%	4.0%	4.0%
24	Real interest rate	3.0%	3.0%	3.0%	3.0%	3.0%
25	Risk premium for cost of debt	5.08%	5.08%	5.08%	5.08%	5.08%
26	Risk premium for ST investment	–0.39%	–0.39%	–0.39%	–0.39%	–0.39%
27	Policies and goals					
28						
29						
30	Inventory as % of COGS	8.49%	8.49%	8.49%	8.49%	8.49%
31	Accounts receivable as % of sales	5.20%	5.20%	5.20%	5.20%	5.20%
32	Accounts payable as % of purchases	9.60%	9.60%	9.60%	9.60%	9.60%
33	Payout ratio	71.75%	71.75%	71.75%	71.75%	71.75%
34	Minimum cash required. As % of sales revenues	2.69%	2.69%	2.69%	2.69%	2.69%
39	Price of new investment in year 8			65.0		
40	Repurchase of equity as a % of funds generated by depreciation	0%	0%	0%	0%	0%

Table E2 Intermediate tables

	B	I	J	K	L	M	N	
	Year	5	6	7	8	9	10	
41	Nominal increase in prices							
42	Selling		5.34%	5.07%	4.56%	4.06%	4.06%	= (1 + J$17) * (1 + J18) − 1
43	Purchase		4.92%	4.57%	4.07%	3.57%	3.57%	= (1 + J$17) * (1 + J19) − 1
44	Overhead expenses		5.75%	4.88%	4.38%	3.88%	3.88%	= (1 + J$17) * (1 + J20) − 1
45	Payroll expenses. Assumed as real increase in the administrative and selling expenses		5.34%	5.99%	5.48%	4.97%	4.97%	= (1 + J$17) * (1 + J21) − 1
46	Increase factor in volume		1.030	1.030	1.030	1.040	1.040	= +(1 + J23)
47								
48	Basic input variables calculation							
49	Sales in units	54.2	55.8	57.5	59.2	61.6	64.0	= I52 * J49
50	Selling price	9.5	10.0	10.5	10.9	11.3	11.8	= I53 * (1 + J42)
51	Total sales		557.9	600.8	643.9	696.9	754.1	= +J53 * J52
52	Price of asset in year 8				65.0			
53	Risk-free rate (Rf)		7.12%	7.12%	7.12%	7.12%	7.12%	= ((1 + J17) * (1 + J24) − 1)
54	Return of short-term investment		6.73%	6.21%	5.70%	5.70%	5.70%	= +J59 + J26
55	Cost of debt, K_d, from CAPM = Rf + risk premium in cost of debt		12.20%	11.69%	11.17%	11.17%	11.17%	= J59 + J25

(continued)

Table E2 (continued)

	B	I	J	K	L	M	N	
	Year	5	6	7	8	9	10	
56	Minimum cash		14.99	16.14	17.30	18.72	20.26	= +J34 * J99
57	Depreciation schedule							
58	Beginning fixed assets		42.2	42.2	42.2	107.2	107.2	= +I75
59	Depreciation investment year 4	14.1	14.1	14.1	14.1			= +I66
60	Depreciation investment year 5		0.0	0.0	0.0	0.0		= +I74/D6
61	Depreciation investment year 6			3.5	3.5	3.5	3.5	= +J74/D6
62	Depreciation investment year 7				4.4	4.4	4.4	= +K74/D6
63	Depreciation investment year 8					21.7	21.7	= +L74/D6
64	Depreciation investment year 9						7.4	= +M74/D6
65	Annual depreciation		14.1	17.6	22.0	29.7	37.1	= SUM(J66:J71)
66	Cumulated depreciation		73.2	90.7	112.7	142.4	179.5	= +J72 + I73
67	New fixed assets		14.1	17.6	87.0	29.7	37.1	= J58 + J72
68	Net fixed assets		42.2	42.2	107.2	107.2	107.2	= +J65 − J72 + J74
69	Inventory valuation using FIFO							

(continued)

Table E2 (continued)

	B	I	J	K	L	M	N	
	Year	5	6	7	8	9	10	
70	Inventory and purchases in units							= +J80 − I80 + J79
71	Units sold		55.81	57.48	59.20	61.57	64.04	= +J52
72	Final inventory in units		4.74	4.88	5.02	5.22	5.43	= J79 × J30
73	Initial inventory in units		4.55	4.74	4.88	5.02	5.22	= I80
74	Purchases in units		55.99	57.62	59.35	61.77	64.24	= J79 + J80 − J81
75	Unitary cost of purchase		6.95	7.24	7.49	7.76	8.04	= +I83 × (1 + J43)
76								
77	Cost of goods sold (COGS) calculation							
78	Initial inventory in dollars		30.3	32.9	35.3	37.6	40.6	= +I88
79	Purchases in dollars		389.3	417.0	444.8	479.5	516.4	= +J82 × J83
80	Final inventory in dollars		32.9	35.3	37.6	40.6	43.7	= +J80 × J83
80	COGS		386.7	414.6	442.4	476.6	513.3	= +J86 + J87–J88
81	Overhead expenses.		31.1	32.4	33.7	35.0	36.3	= I90 × (1 + J$44)
[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]	[…]
82	Administrative and selling expenses	69.19	73.34	77.35	81.20	85.23	89.47	= +I96 × (1 + J45)
83								
84	Sales and purchases							
85	Total sales revenues	515.5	557.9	600.8	643.9	696.9	754.1	= +J54
86	Inflow of sales revenues for current year	500.0	528.9	569.6	610.4	660.6	714.9	= +J54 × (1 − J31)
87	Credit sales (1 year)	15.5	29.0	31.2	33.5	36.2	39.2	= +J99 × J31

(continued)

Table E2 (continued)

	B	I	J	K	L	M	N	
	Year	5	6	7	8	9	10	
88	Total purchases	360.5	389.3	417.0	444.8	479.5	516.4	$=+J87$
89	Purchases paid the same year	331.7	351.9	376.9	402.1	433.4	466.9	$=+J87\times(1-J32)$
90	Purchases on credit (1 year)	28.8	37.4	40.0	42.7	46.0	49.6	$=+J102-J103$
91								
92	Inflows from sales							
93	Inflow of sales revenues for current year	500.0	528.9	569.6	610.4	660.6	714.9	$=+J100$
94	Inflows from accounts receivables	33.6	15.5	29.0	31.2	33.5	36.2	$=I101$
95	Total inflows	533.6	544.3	598.6	641.7	694.1	751.1	$=+J108+J107$
96	Purchases paid the current year	331.7	351.9	376.9	402.1	433.4	466.9	$=+J103$
97	Payment of accounts payable	23.5	28.8	37.4	40.0	42.7	46.0	$=I104$
98	Total payments for purchases	355.1	380.8	414.3	442.1	476.1	512.9	$=+J111+J110$

Table E3 Forecasted cash budget

	B	I	J	K	L	M	N	
	Year		6	7	8	9	10	
99	Cash budget							
100	Module 1: operating activities							
101	Cash inflows							
102	Total accounts receivable (AR) plus sales on cash		544.32	598.58	641.69	694.10	751.14	= +J109
103	Total inflows		544.32	598.58	641.69	694.10	751.14	= J117
104	Cash outflows							
105	Total payments for purchases		380.79	414.32	442.13	476.14	512.88	= +J112
106	Overhead and administrative and selling expenses		104.39	109.77	114.87	120.21	125.80	= +J96 + J90
107	Income taxes		17.29	19.68	22.03	22.67	25.63	= +J194
108	Total cash outflows.		502.47	543.77	579.02	619.02	664.31	= SUM(J120 : J122)
109	Net cash balance (NCB) before fixed assets purchase		41.86	54.81	62.67	75.08	86.83	= J118 – J123
110	Module 2: investment in assets							
111	Purchase of fixed assets		14.08	17.60	86.99	29.67	37.08	= +J74
112	NCB of investment in assets		–14.08	–17.60	–86.99	–29.67	–37.08	= –J127 – J126
113	NCB after fixed assets investment		27.78	37.21	–24.33	45.41	49.75	= +J124 + J128
114	Module 3: external financing							

(continued)

Table E3 (continued)

	B	I	J	K	L	M	N	
	Year		6	7	8	9	10	
115	Inflow of loans							
116	LT (long-term) loan 1–5 years							
117	ST (short-term) loan 2		0.0	0.0	0.0	0.0	0.0	= IF((J124 – J138 – J139) > 0, 0, –(J124 – J138 – J139))
118	LT loan 3 10 years	0.0	0.00	0.00	21.56	0.00	0.00	= IF((I155 + J129 + J133 – J136 – J141 + J147 + J150 + J151 – J$62) > 0, 0, –(I155 + J129 + J133 – J136 – J141 + J147 + J150 + J151 – J$62))
119	Payment of loans							
120	Principal LT loan 1		0.0	0.0	0.0	0.0	0.0	
121	Interest LT loan 1		0.0	0.0	0.0	0.0	0.0	
122	Principal ST loan 2		0.0	0.0	0.0	0.0	0.0	= +I133
123	Interest ST loan 2		0.0	0.0	0.0	0.0	0.0	= +J169
124	Principal LT loan 3		5.17	5.17	5.17	7.32	7.32	= +J320 + J328
125	Interest LT loan 3		5.41	4.58	3.80	5.63	4.81	= +J176
126	NCB of financing activities		–10.58	–9.75	12.59	–12.95	–12.13	= SUM(J132 : J134) –SUM(J136 : J141)
127	Module 4: transactions with owners							
128	Initial invested equity							
129	Dividends payment		17.17	23.04	26.23	29.35	30.21	= +I196
130	Repurchase of stock		0.00	0.00	0.00	0.00	0.00	= +J198

(continued)

Table E3 (continued)

	B	I	J	K	L	M	N	
	Year		6	7	8	9	10	
131	NCB of transactions with owners		–17.17	–23.04	–26.23	–29.35	–30.21	= +J144 – J145 – J146
132	NCB for the year after previous transactions		0.04	4.43	-37.96	3.11	7.40	= +J147 + J142 + J129
142	Module 5: discretionary transactions							
133	Redemption of ST investment.	0.00	30.65	31.77	37.01	0.00	1.68	= I152
134	Return from ST investments	0.00	2.06	1.97	2.11	0.00	0.10	= J60 × J150
135	ST investments	30.65	31.77	37.01	0.00	1.68	7.65	= IF(J133 > 0, 0, (IF((I155 + J148 + J150 + J151 – J62) > 0, I155 + J148 + J150 + J151 – J62, 0)))
136	NCB of discretionary transactions		0.95	–3.28	39.12	–1.68	–5.86	= +J150 + J151 – J152
137	Year NCB		0.99	1.15	1.16	1.42	1.54	= +J153 + J147 + J142 + J128 + J124
138	Cumulated NCB	14.00	14.99	16.14	17.30	18.72	20.26	= +I155 + J154
139	LT loan 1 schedule							
140	Beginning balance		0.0	0.0	0.0	0.0	0.0	= I164
141	Interest payment LT 1		0.0	0.0	0.0	0.0	0.0	= J165 × J160

(continued)

Table E3 (continued)

	B	I	J	K	L	M	N	
	Year		6	7	8	9	10	
1442	Principal payments LT 1							
143	Total payment LT 1		0.0	0.0	0.0	0.0	0.0	= J161 + J162
144	Ending balance	0.0	0.0	0.0	0.0	0.0	0.0	= J160 − J162
145	Interest rate		12.20%	11.69%	11.17%	11.17%	11.17%	= +J61
146	ST loan 2 schedule							
147			6	7	8	9	10	
148	Beginning balance							
149	Interest payment ST 2		0.0	0.0	0.0	0.0	0.0	= +I172 × J173
150	Principal payments ST 2		0.0	0.0	0.0	0.0	0.0	= +I172/$D$15
151	Total payment ST 2		0.0	0.0	0.0	0.0	0.0	= SUM(J169 : J170)
152	Ending balance	0.0	0.0	0.0	0.0	0.0	0.0	= +I172 − J170 + J133
153	Interest rate		12.20%	11.69%	11.17%	11.17%	11.17%	= +J165
154			6	7	8	9	10	
155	Beginning balance	49.51	44.34	39.17	34.00	50.39	43.07	= +I180
156	Interest payment LT 3	6.21	5.41	4.58	3.80	5.63	4.81	= +J181 × I180
157	Principal payments LT 3	5.17	5.17	5.17	5.17	7.32	7.32	= +I177 + I134/$D$14
158	Total payment LT 3	11.37	10.58	9.75	8.97	12.95	12.13	= J176 + J177
159	New debt		0.00	0.00	21.56	0.00	0.00	= +J134
160	Ending balance	44.34	39.17	34.00	50.39	43.07	35.74	= +J175 − J177 + J179
161	Interest rate	12.54%	12.20%	11.69%	11.17%	11.17%	11.17%	= J165

Table E4 Forecast for the income statement

	B	I	J	K	L	M	N	
	Year	5	6	7	8	9	10	
162	Income statement.							
163	Sales revenues		557.9	600.8	643.9	696.9	754.1	= +J54
164	Cost of goods sold (COGS)		386.7	414.6	442.4	476.6	513.3	= +J89
165	Gross income		171.2	186.2	201.5	220.3	240.8	= J184 − J185
166	Overhead expenses		31.1	32.4	33.7	35.0	36.3	= +J90
167	Administrative and selling expenses		73.3	77.4	81.2	85.2	89.5	= +J96
168	Depreciation		14.1	17.6	22.0	29.7	37.1	= J72
169	Earnings before interest and taxes (EBIT)		52.7	58.8	64.6	70.4	77.9	= J186 − J188 − J189 − J187
170	Interest payments		5.4	4.6	3.8	5.6	4.8	= +J161 + J176 + J169
171	Return (interest) from short-term (ST) investment		2.1	2.0	2.1	0.0	0.1	= +J60 × I152
172	Earnings before taxes (EBT)		49.4	56.2	62.9	64.8	73.2	= J190 + J192 − J191
173	Income taxes		17.3	19.7	22.0	22.7	25.6	= IF(J193 ≤ 0, 0, J193 × $D$8)
174	Net income		32.1	36.6	40.9	42.1	47.6	= J193 − J194
175	Dividends		23.0	26.2	29.4	30.2	34.1	= IF(J195 < 0, 0, J195 × J33)
176	Cumulated retained earnings	20.6	27.3	36.3	46.7	58.2	70.1	= +I197 + I195 − I196
177	Repurchase of equity		0.0	0.0	0.0	0.0	0.0	= +J189 × J40

Table E5 Balance sheet

	B	C	I	J	K	L	M	N	
		Year	5	6	7	8	9	10	
178	Balance sheet								
179	Assets	Year							
180	Cash	CB		15.0	16.1	17.3	18.7	20.3	= J155
181	AR.	IT		29.0	31.2	33.5	36.2	39.2	= J101
182	Inventory	IT		32.9	35.3	37.6	40.6	43.7	= +J88
183	ST investments	CB		31.8	37.0	0.0	1.7	7.6	= +J152
184	Current assets			109.3	112.9	77.2	83.4	90.1	= SUM(J202:J205)
185	Total fixed assets	IT		42.2	42.2	107.2	107.2	107.2	= +J75
186	Total			150.92	161.92	195.66	204.42	218.02	= J207 + J204 + J203 + J202 + J205
187	Liabilities and equity.								
188	AP	IT		37.4	40.0	42.7	46.0	49.6	= J104
189	ST debt	CB		0.0	0.0	0.0	0.0	0.0	= +J172
190	Current liabilities			37.4	40.0	42.7	46.0	49.6	= SUM(J210:J211)
191	LT debt	CB		39.2	34.0	50.4	43.1	35.7	= +J180 + J164
192	Total liabilities			76.5	74.0	93.1	89.1	85.3	= +J213 + J212
193	Equity investment	ID	15.0	15.0	15.0	15.0	15.0	15.0	= +I215 + J144
194	Retained earnings	IS		27.3	36.3	46.7	58.2	70.1	= J197
195	Current year net income			32.1	36.6	40.9	42.1	47.6	= +J195
196	Repurchase of equity		0.0	0.0	0.0	0.0	0.0	0.0	= +I218 − J146
197	Total liabilities and equity			150.92	161.92	195.66	204.42	218.02	= SUM(J210:J218) − J214 − J212
198	Check			0.0000000	0.0000000	0.0000000	0.0000000	0.0000000	= J219 − J208

References

Arnold TM, Peter CE (2007) Debt financing does not create a circularity within pro forma analysis (February 26). Available at SSRN: http://ssrn.com/abstract=965547

Benninga S (2006) Principles of finance with excel. Oxford, London

Benninga S (2007) Conference: teaching of finance with excel. Guest Speaker in 4th National and 1st International Symposium for the Teaching in Finance, Cartagena, June 20. ISSN 1900-3218

Brealey RA, Stewart CM, Alan JM (1995) Fundamentals of corporate finance. McGraw-Hill, NY

Daves PR, Michael CE, Ronald ES (2004) Corporate valuation: a guide for managers and investors. Thomson, OH

Day AL (2001) Mastering financial modeling. a practitioner's guide to applied corporate finance. Prentice Hall, London

Gallagher TJ, Joseph DA Jr (2000) Financial management, 2nd ed. Prentice Hall, London

Google Search on 2 August 2007 for "plug forecasting financial statements": http://www.google.com.co/search?hl=es&q=plug+forecasting+financial+statements&btnG=Buscar&meta=

Higgins RC (2001) Analysis for financial management, 6th ed. Irwin-McGraw-Hill, NY

Horngren CT, Gary LS, John AE, Donna P (2005) Introduction to financial accounting, 9th ed. Prentice-Hall, London

Jensen MC (1986) Agency cost of free cash flow, corporate finance, and takeovers. Am Econ Rev 76(2):323–329. Available at SSRN: <http://ssrn.com/abstract=99580> or DOI: 10.2139/ssrn.99580

Kester GW (1987) A note on solving the balancing problem. Financ Manag 16(1):52–54

Palepu KG, Paul MH, Victor LB (2004) Business analysis & valuation. Using financial statements, Thomson, OH

Penman SH (2001) Financial statement analysis & security valuation, Irwin-McGraw-Hill, NY

Pinkowitz L, Rohan W, René MS (2007) Cash holdings, dividend policy, and corporate governance: a cross-country analysis. J Appl Corp Finance 19(1)

Polimeni RS, Frank JF, Adelberg A (1991) Cost accounting concepts and applications for managerial decision making. McGraw-Hill, New York

Ross SA, Randolph WW, Jeffrey J (1999) Corporate finance, 5th ed. Irwin-McGraw-Hill, NY

Ruback RS (2002) Capital cash flows: a simple approach to valuing cash flows. Financ Manag Summer:85–103

Tham J, Vélez Pareja I (2004) Principles of cash flow valuation. an integrated market based approach. Academic Press, London

The Happy Accountant. http://happyaccountant.wordpress.com/2007/07/03/advantages-of-double-entry-bookkeeping/ (Visited on July 23, 2007)

Tjia JS (2004) Building financial models. a guide to creating and interpreting financial statements. McGraw-Hill, New York

Van Horne JC (1998) Financial management and policy, 11th ed. Prentice Hall, Englewood Cliffs, New Jersey

Van Horne JC (2001) Financial management and policy, 12th ed. Prentice Hall, Englewood Cliffs, New Jersey

Velez-Pareja I (2002) Use of inflation as the basis to estimate nominal increases in prices (July 8). Working Paper No. 15. Available in SSRN: http://ssrn.com/abstract=319940 or DOI:10.2139/ssrn.319940

Velez-Pareja I (2005) Why we subtract the change in working capital when defining free cash flows? A pedagogical note (May 11). Available at SSRN: http://ssrn.com/abstract=718741

Vélez Pareja I (2007a) Decisiones de inversión. Para la valoración de proyectos y de empresas, Universidad Javeriana, Politécnico Grancolombiano. Bogotá

Velez-Pareja I (2007b) Guidelines for forecasting financial statements from historical financial statements for valuation purposes (Updated) (July 13). Available at SSRN: http://ssrn.com/abstract=872474

Velez-Pareja I (2007c) Which cost of debt should be used in forecasting cash flows? (Sept. 2). Available at SSRN: http://ssrn.com/abstract=101148

Velez-Pareja I, Carlo AM (2008) Potential dividends and actual cash flows – theoretical and empirical reasons for using actual and dismissing potential, or how not to pull potential rabbits out of actual hats (March 10). Available at SSRN: http://ssrn.com/abstract=1095068

Velez-Pareja I, Mariano M, David AL, Julio S, Carlo AM (2008) Dividends paid, potential dividends in five latin american countries (Preliminary Report, in press)

Chapter 9
The EVA Approach to Investing

Chandrasekhar Krishnamurti

9.1 Chapter Introduction and Objectives

That there is no profit unless the company earns the cost of capital is at the heart of some relatively new performance metrics like economic value added (EVA), which is defined as the difference between the net operating profit after taxes and the capital consumed. Many companies around the world have announced their commitment to improving their EVA. Analysts and fund managers who evaluate investment potential from the perspective investors are increasingly turning to EVA as an indicator of firm performance. This chapter discusses the EVA approach to investing.

This chapter discusses the following objectives:

- Discuss the calculation and characteristics of EVA
- Highlight competitors to EVA
- Provide evidence on EVA companies
- Highlight how the implementation of EVA can lead to value enhancing strategies in a firm

Since the objective of a firm is to maximize shareholders' wealth, a performance measure should have high correlation with changes in shareholders' wealth. Managers are commonly appraised on measures like return on assets, earnings per share, and return on equity that does not capture value. Managers focus on cash flows while evaluating capital investments; but when it comes to performance measurement, accounting measures take over. If a company changes its accounting method from first-in-first-out (FIFO) to last-in-first-out (LIFO) during a period of high inflation, cash flow increases but earnings fall. Similarly, when a company acquires another company, there may be special write-offs like amortization of good will that

C. Krishnamurti
AUT University College of Business, WF Building, Wellesley Campus, 42 Wakefield Street, Auckland 1010, New Zealand
e-mail: Chandrasekhar.krishnamurti@aut.ac.nz

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_9,

are noncash in nature. The earnings per share falls but cash flow is unaltered. Moreover, these measures can be easily manipulated due to "denominator management." One can increase the value of these ratios by simply cutting down whatever that appears in the denominator.

Profit itself is not an appropriate measure of performance because it does not capture either the amount of capital used to generate those earnings or the required rate of return on capital. A good performance measure is one that incorporates all three.

EVA[1] is an accounting-based measure of operating performance. The period could be a month, quarter, half year, or a year. The entity whose performance is being measured could be a division or the firm itself. EVA is the difference between accounting earnings – with suitable adjustments for interest and some accounting methods – and the cost of capital used to generate these earnings.

9.2 Competitors to EVA

One of the measures of shareholder value is the total shareholder return (TSR). It is the rate internal rate of return (IRR) that equates the purchase price (cash outflow) and dividends and sales proceeds (cash inflows) at the end of the holding period.

If the holding period is 1 year

$$\mathrm{TSR} = \mathrm{Div} + \frac{(P_1 - P_0)}{P_0}.$$

The TSR of the company may be compared with that of the peer group to evaluate performance. For instance, the TSR may be adjusted for index return. Exhibit 9.1 presents the list of top performers in the United States on the basis of relative (TSR–S&P) for the period 1989–1998.

The Boston Consulting Group examines the performance of large, quoted companies from around the world and ranks them on the basis of TSR. Exhibit 9.2 gives the list of top ten companies on the basis of average annual TSR for the 2000–2004.[2] The disadvantage of TSR is that it cannot be calculated at the SBU level or for private companies.

Under the *residual income* method, an explicit cost of capital is specified for the investment centre and is applied on the investment base to arrive at the capital charge. To illustrate, if the invested capital is \$ 100,000 and earning before interest and taxes (EBIT) is \$ 40,000, the residual income at a capital cost of 15% would be as follows:

$$\begin{aligned}\text{Residual income} &= \text{EBIT} - (\text{Cost of capital} \times \text{Invested capital}),\\ &= 40000 - (0.15 \times 100000),\\ &= \$\,25000.\end{aligned}$$

[1] EVA is the registered trademark of Stern Stewart & Co.

[2] More recent rankings are available on the BCG website www.bcg.com.

Exhibit 9.1 Consistent performers: 1989–1998

Company	Relative 10 yr TSR-S&P
General mills	82.5
Avon products	151.0
UST Inc	91.3
Gillette Co	153.4
Ralston Purina	73.8
Schering Plough	180.1
Coca-Cola	156.4
SLM HLDG Corp	102.3
Unilever NV	115.7
Kellogg	54.1

Source: Morin and Jarrell (2001)

Exhibit 9.2 The global top ten 2000–2004

Ranking	Company	TSR %
(1)	Hyundai Motors	69.7
(2)	Harman Intl	55.7
(3)	NOK	55.3
(4)	Dr Horton	52.9
(5)	Vale Do Rio Doce	48.5
(6)	Esprit Holdings	44.5
(7)	Petsmart	44.1
(8)	Varian Medical	42.1
(9)	Enterprise Inns	41.0
(10)	St. Jude Medical	40.5

Source: Boston Consulting Group

Cash flow return on investment (CFROI), developed by HOLT Value Associates, is an IRR type measure that represents the real return on investment expected over the average life of the firm's existing assets. It is normally calculated on an annual basis and is compared to an inflation-adjusted cost of capital to determine whether a company has earned returns superior to its cost of capital. An advantage of CFROI is that it ties performance measurement to the factor that capital markets value the most – ability to generate cash flow. CFROI can be calculated either for a division or even privately held companies. The calculation of CFROI is a five step process:

- Calculate the average life of the firm's assets by dividing gross depreciable assets by the depreciation expense. Gross depreciable assets are estimated as the firm's gross property, plant and equipment, minus the value of land and construction in progress.
- Calculate gross cash flow

$$\text{Net income before extraordinary items} + \text{Depreciation and amortization}$$
$$+ \text{Interest expense} + \text{Operating rental expense} + \text{Deferred taxes} = \text{Gross cash flow.}$$

- Calculate gross cash investments = gross PP&E + present value of operating lease payments + goodwill and accumulated goodwill amortization
- Calculate the sum of all non-depreciating assets such as land, working capital and other assets (essentially a terminal value)
- Solve for CFROI = return that equates the gross cash investments to the present value of future gross cash flows plus a terminal value
- Terminal value = working capital plus land and other non-depreciating assets

9.3 Characteristics of EVA

EVA is an accounting-based measure of operating performance. The period could be a month, quarter, half year or a year. The entity whose performance is being measured could be a division or the firm itself. EVA is the difference between accounting earnings – with suitable adjustments for interest and some accounting methods – and the cost of capital used to generate these earnings.

Expressed as a formula,

$$\text{EVA} = \text{NOPAT} - (\text{WACC} \times \text{Net Assets}),$$

where NOPAT = net operating profit after tax = EBIT (1-T) = [sales- COGS- SGA-depreciation] (1-t)

Net assets = adjusted book value of net capital at the beginning of the period,
WACC = weighted average cost of capital = $\frac{D}{V}\,(1-T)K_{\mathrm{d}} + \frac{E}{V} \times K_{\mathrm{e}}$,

where D = market value of firm's debt

E = market value of equity = Number of shares × current market price

Convertible debt/preferred securities must be converted if in the money and options must be included if in the money

$V = D + E$

T = marginal tax rate

K_{d} = marginal cost of borrowing long term after adjusting for offering discount and issuance cost.

K_{e} = cost of equity estimated by capital asset pricing model

EVA is founded on the idea that there is no profit as long as the enterprise does not earn the cost of capital consumed.

EVA has certain characteristics:

- It provides greater accountability for investor capital as it measures the required return on all investments.

- It is custom made to a company's specific circumstances making only those accounting adjustments that are necessary.
- It is easy to communicate.
- It aligns managerial and shareholders' interests by tying management compensation to improvements in EVA.

EVA differs from residual income method in several ways. First, it does not take balance sheet numbers directly since a balance sheet is prepared on historical cost basis. Accounting adjustments are made to produce a balance sheet that reflects economic values of assets in place and remove the effect of managers' focus on current earnings. Stern Stewart & Co. considers about 250 accounting adjustments in moving to EVA. In defining and refining its EVA measure, Stern Stewart & Co has identified over 120 shortcomings in conventional accounting. In reality, however, only a small number of accounting adjustments are made. An analyst should make the following adjustments to the financial statements before calculating NOPAT and invested capital:

- Capitalize and amortize research and development charges (rather than expense them), and add them back to earnings to calculate NOPAT
- Capitalize (but do not amortize) goodwill, add amortization expense back to earnings to get NOPAT, and add accumulated amortization back to invested capital. These adjustments are important if the financial statements are prepared using IAS. Under the US GAAP goodwill is not amortized; instead, it is subject to an annual impairment test.
- Treat operating leases as capital lease and adjust non-recurring items
- Add back charges on strategic investments that will generate returns in the future
- Do not apply capital charge to strategic investments that are not expected to generate economic profit until sometime in the future
- Do not include deferred taxes in the calculation of NOPAT. Apply marginal tax rate based on cash taxes
- Add back LIFO reserve to capital

Another reliable measure of management's long run success in adding value is Market Value Added (MVA). The aim of management is to maximize the amount by which the company's market value exceeds the capital supplied by the firm's investors. MVA is the difference between the company's current market value, as determined the market price of its securities and its economic book value.

$$\text{MVA} = \text{Market capitalization} - \text{Invested capital},$$

where Market capitalization = market value of debt and equity, Invested capital = book value of debt and equity including equity equivalent reserves like R&D expenses.

Thus, if a company's market value of debt and equity are \$ 100 million and the adjusted book value of capital is \$ 50 million, the MVA is \$ 50 million. A negative

MVA implies that the company will generate returns below its cost of capital whereas a positive MVA implies the opposite. If MVA is a better indicator of performance, why calculate EVA? MVA has a limitation. MVA cannot be calculated for privately held firms and non-profit organizations, as they are not listed on stock exchange.

9.4 Global Ranking of High-Growth Value Adders

The list of top high-growth value adders in North America, Europe, Asia, Africa and Australia is presented in Exhibit 9.3.[3] Stern Stewart ranked companies on the basis of revenue growth as well as on MVA and then on the ratio of MVA to revenue growth. To produce a composite ranking, they add the revenue growth score and the MVA/revenue scores. The lower the combined number, the higher is the company's position in the list of high-growth value adders.

9.5 How Do Companies use EVA to Improve Performance?

There are countless individual operational things that create shareholder value and increase EVA. There are five generic ways in which EVA can be increased:

Exhibit 9.3 Top high-growth value adders in North America, Europe, Asia, Africa and Australia

	North America	Europe	Asia	South Africa and Australia
Rank	Company	Company	Company	Company
1	GE	Nestle	Toyota	BHP Billiton
2	Wal-Mart	Total	NTT	Telstra
3	Altria group	Glaxosmithkline	Samsung	News Corporation
4	Home Depot	Eni	Sony	Woolworths
5	Microsoft	BP	Honda	Rio Tinto
6	Exxon Mobil	Royal Dutch Shell	Canon	SAB Miller
7	IBM	Nokia	Mitsubishi	Coles Myer
8	Johnson & Johnson	France Telecom	Hitachi	Brambles Group
9	Pfizer	Deutsche Telekom	Hitachi	Wesfarmers
10	Dell	Telefonica	NEC	Amcor

Source: Stewart (2004)

[3] More recent EVA and MVA rankings are available from Stern Stewart & Co. See www.sternstewart.com.

(1) increase revenues (2) reduce operating expenses (3) use less invested capital (4) take advantage of positive NPV projects, and (5) reduce WACC.[4]

Often EVA does not directly help in finding ways to improve operational efficiency except when improving capital turnover. Nor does EVA help directly in finding strategic advantages that enable a company to earn abnormal returns and thus create shareholder value. It is, however, often helpful to understand the basic ways in which EVA and thus the wealth of shareholders can be improved. Increasing EVA falls always into one of the following three categories:

1. Generating more operating profits without tying any more capital in the business
2. Making NPV-positive investments
3. Capital is withdrawn or liquidated from businesses that fail to earn return greater than the cost of capital.

The first method includes all the countless ways to improve operating efficiency or increase revenues.

The third category, withdrawing capital, is probably not so widely understood and applied as the previous ones. It is, however, also very important to realize that shareholder value can also be increased if capital is withdrawn from businesses earning less than the cost of capital. Even if an operation has positive net income, it might pay to withdraw capital from that activity. It is also kind of withdrawal when access inventories and receivables and thus the capital costs caused by them are reduced without corresponding decreases in revenues.

Most adopters of EVA financial management system experience improvements in NOPAT margin and average capital turnover. The Indian clients of Stern Stewart, for example, report 3% increase in NOPAT margin and 66% increase in average capital turnover within 2 years of implementation of value-based management (Gandhok and Kulkarni 2005). Adopters of EVA financial management system also experience several intangible benefits like improved strategic planning, efficient resource allocation, improved capital focus, improved decision-making and more effective organizational communication.

9.6 Economic Value Added and Net Present Value

EVA is directly linked to wealth creation via the net present value (NPV) rule. Modern capital budgeting prescribes that all projects with positive NPV be chosen. The total shareholder value is simply the sum of NPVs of all projects undertaken by the firm. That is,

$$\text{Enterprise value} = \text{invested capital} + \text{NPV, that is, } V = C + \text{NPV}.$$

[4] WACC can be reduced and EVA increased by decreasing the volatility of NOPAT (i.e., reducing the firm's business risk).

Divide both sides by capital

$$V/C = 1 + (\text{NPV}/C),$$

where $V/C =$ Market-to-book ratio of a firm.
But

$$\begin{aligned}\text{NPV} &= \text{MVA},\\ &= \text{Present value of expected EVA}\\ &= \text{EVA/WACC if the EVA stream is assumed to be perpetual}\end{aligned}$$

Therefore,

$$\begin{aligned}V/C &= 1 + [(\text{EVA}/\text{WACC})/C],\\ &= 1 + [\text{ROC} - \text{WACC}]/\text{WACC}.\end{aligned}$$

That is, the *V*/*C* ratio is greater than 1 if the firm has discounted positive EVA.

Market values are above all based on expectations about the future cash flows. Changes in the current share prices thus reflect changes in future cash flow and future EVA expectations. Therefore, current EVA can never explain current share prices very well. Change in current EVA might imply some change in future EVA and therefore EVA has some explanatory power. On the contrary the change in future EVA is surely visible also in other measures than EVA. Therefore, it is understandable that the other measures have almost as much explanatory power and it is also understandable that the explanatory level is quite low with every measure. Still, current research on the subject seems to suggest that EVA has some additional information compared to conventional measures. However, EVA should not be viewed as a magic wand, which can explain current share prices with current performance.

9.7 Evidence on EVA Companies

There is evidence that Stern Stewart's EVA clients substantially outperform peers.[5] The latest findings show that the amount of outperformance varies in step with the degree to which companies use EVA, and Stern Stewart's special incentive-plan architecture, as the basis for compensation. The study analyzed total returns to shareholders for up to 5 years after companies began to implement EVA with Stern Stewart's assistance. On average, investments in the shares of these companies produced 49% more wealth after 5 years than equal investments in shares of competitors with similar market capitalizations. Companies that used the full Stern Stewart compensation architecture did even better. Investment in their shares produced 84% more wealth over 5 years than equal investments in their competitors. Overall, the Stern Stewart clients created some $ 116 billion more in market value

[5] This section is based on the findings of Stern Stewart & Co. See www.sternstewart.com.

than they would have if they had performed the same as their competitors. The study includes 66 publicly owned US clients for which at least 24 months of stock performance data were available. The starting date for each comparison is the month that a company began to implement EVA. The performance comparisons were made against competitors in the same (four-digit SIC 9Standard Industrial Classification) codes as the EVA companies. The competitors used in the study, which they call comparators, were the ten closest in market capitalization to the EVA company at the starting date. In a handful of cases, fewer than ten comparators were available. Using companies in the same industries and with similar market capitalizations eliminates as much "systematic" risk as possible, so that comparisons reflect specific company performance to the greatest extent possible. Exhibit 9.4 presents the performance of some EVA companies.

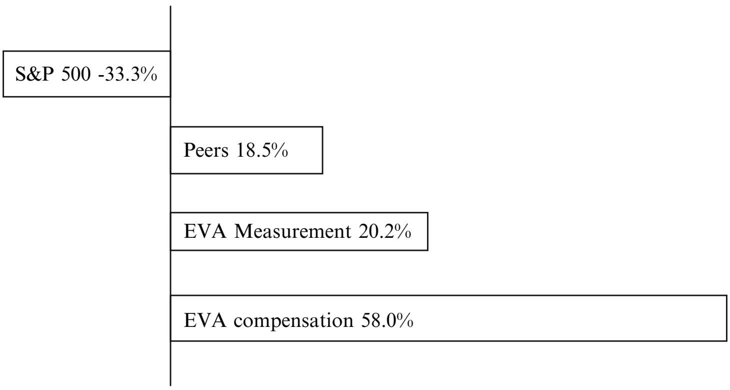
Exhibit 9.5 presents the performance of EVA companies vis-à-vis peers and the S&P 500 for the period March 2000–June 2002 and 1 July 1997–30 June 2002. Exhibit 9.6 presents the total shareholder value for some prominent Stern Stewart US clients relative to the mean total shareholder value for their competitors.

Exhibit 9.4 Performance of some Economic Value Added (EVA) companies

Company	Compound rate (5 year)
Bausch & Lomb	45.81
Becton & Dickinson	13.25
Briggs & Stratton	21.85
Coca Cola	13.66
Eli Lilly	2.95
Herman Miller	30.55
Hershey Foods	0.87

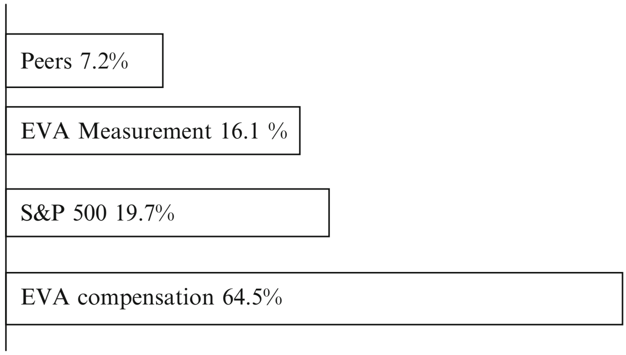
Source: Stern Stewart & Co

Exhibit 9.5 Performance of Economic Value Added (*EVA*) companies vis-à-vis peers and the S&P 500: March 2000–30 June 2002



Source: Stewart et al. (2002)

Exhibit 9.6 Performance of Economic Value Added (*EVA*) companies vis-à-vis peers and the S&P 500: 1 July 1997–30 June 2002



Source: Stewart et al. (2002)

9.8 EVA and Investment Management

Firms are valued using the discounted cash flow (DCF) approach based on the premise that firms are like straight bonds. That is, future cash flows from the underlying asset are discounted at an appropriate discount rate to estimate the value. Firms, in reality, have implicit options embedded in them. Managers, for example, have the option of abandoning a project if the revenues are less than anticipated. Similarly, they have the option of expanding or contracting operations, switch inputs and outputs depending on input and output prices, etc. These are *real* options. So, firms are more like a bond-warrant package than straight bonds. This can be written as follows:

Firm value = value of assets in place + present value of future growth opportunities.

To use EVA for valuation, we need to take into account EVA improvement attributed to future growth opportunities (i.e. from assets not already in place) and add it to the EVA generated by the firm's current assets.

$$\begin{aligned}\text{Market value} = {} & \text{capital} + \text{capitalized current EVA with no growth} \\ & + \text{PV of EVA growth.}\end{aligned}$$

That is, current operations value is simply the present value of EVA assuming 0% growth (i.e., perpetual). The PV of EVA growth can be estimated using a suitable growth rate (i.e., a growing perpetuity).

Typically, a large fraction of intrinsic value can be attributed to expectations of growth. Exhibit 9.7 presents the estimate of components of market value for some prominent companies in 1997.

Exhibit 9.7 Estimate of components of market value for some prominent companies

Company	Current operations value (%)	Future growth value (%)	Market value (%)
Coke	26	74	100
Quaker	27	73	100
Heinz	31	69	100
Kellogg	40	60	100
Hershey	45	55	100
Unilever	48	52	100
Nestle	56	44	100

Source: Pettit (2001)

Close to 75% of Coke's market value in 1997 could be attributed to future growth value.

To estimate the intrinsic value, an analyst may forecast EVA for, say, 5 years and capitalize it at WACC and add it to current capital. The terminal value at the end of 5 years can be estimated in any of the following ways:

- As a perpetuity if the capital is assumed to be constant (any new investment equals depreciation), which is sometimes the case
- Using market multiples like sales multiples or earning before interest, taxes, depreciation and amortization (EBITDA) multiples

The intrinsic value estimate may be used to make investment decisions. The end result of this analysis is as follows:

- Finding companies that are consistently improving EVA
- Reconciling market implied EVA growth imbedded in stock price with what the firm can realistically achieve on a recurring basis

This analysis may be used by portfolio managers to place companies in the four quadrants with EVA spread (i.e. ROC-WACC) on the Y-axis and growth in net invested capital on the X-axis and classify companies as follows:

- Companies for whom growth creates value
- Companies for whom growth destroys value
- Companies with limited investment opportunities even if EVA spread is positive
- Companies with negative EVA spread and contracting business

Analysts interested in stock selection using EVA can graph individual stocks along two dimensions – EVA spread (i.e., ROC − WACC) on the Y-axis and market value-to-replacement cost of invested capital on the X-axis to identify under priced securities. Firms with high EVA spread and low invested capital ratios are under priced and those with low EVA spread and high capital ratio are over priced.

9.9 Concluding Comments

While economic profit itself is not a new idea in finance theory, EVA is certainly more refined and useful for valuation and portfolio management. While some studies have reported positive correlation between EVA and stock prices, others have found the opposite. That is, companies with negative EVA have experienced increases in stock prices and vice versa. This is not contrary to what we would expect. The current stock price is supposed to reflect *future* improvements in EVA just as the current stock price not only reflects the value of assets in place but also future growth opportunities. To that extent the findings are consistent with modern finance theory.

9.10 End of the Chapter Exercises

1. The following data are available for a company for the period 2000–2004.

	($ '000)				
	2000	2001	2002	2003	2004
NOPAT	235,029	270,140	281,950	296,642	362,744
Beginning capital	1,430,280	1,981,285	2,551,826	2,901,126	3,465,870
Long-term debt	1,013,967	2,152,208	2,577,134	1,546,824	3,255,236
Av. shares outstanding	46,970	49,840	51,905	52,670	52,272
Share price	58	66	44	49	45
Tax rate %	45	46	34	34	34
T-Bond rate %	10.74	8.14	8.76	9.11	8.62
Yield on the company's bond %	12.19	10.37	10.55	10.75	10.35
Beta	1.35	1.3	1.15	1.10	1.10

Calculate EVA, cumulative annual EVA, and percentage change in cumulative EVA between 1985 and 1989. If the book value of equity is $815,000 in 1985, calculate MVA.

2. Consider the following data.

Company	ROCE%	WACC%
A	16	13
B	16	17

Indicate which company's stock you would buy. Why?

3. Describe the competitors to EVA as a metric.
4. What is the relationship between NPV, EVA and MVA?
5. How can companies use EVA to improve performance?
6. Summarize the findings on EVA companies.
7. What, if any, are the limitations of using EVA for stock picking?

References

Abate J, Grant J, Stewart B (2004) The EVA style of investing. J Portfolio Manage

Gandhok T, Kulkarni S (2005) Stern stewart's clients create more wealth by outperforming their peers. Evaluation

Haspeslagh P, Noda T, Boulos F (2001) It's not just about the numbers. Harvard Business Review

Morin R, Jarrell S (2001) Driving shareholder value: value building techniques for creating shareholder wealth. McGraw Hill

Pettit J (2001) EVA & strategy II: portfolio management. Evaluation 3

Pettit J, Dower J, Pichler K, Perez J (2001) EVA & corporate portfolio strategy. Evaluation 3

Stewart B (2004) Champions of profitable growth. Harvard Business Review

Stewart B, Ellis M, Budington D (2002) Stern Stewart's EVA clients outperform the market and their peers. Evaluation

Chapter 10
DCF Valuation Models: Free Cash Flow, APV, ECF, and CCF Valuation Models

S.R. Vishwanath

10.1 Chapter Introduction and Objectives

It is now a common practice to use discounted cash flow (DCF) models to value companies. The DCF models are based on the premise that profit itself does not tell us much. We must also take into account the investment required to generate the profits. Analysts who use DCF models have to choose from at least four approaches: free cash flow (FCF) to firm valuation, equity cash flow valuation, capital cash flow (CCF) valuation, and adjusted present value (APV). This chapter provides an overview of these approaches.

This chapter has the following objectives:

- Discuss calculation of FCFs
- Discuss approaches for the estimation of terminal value
- Discuss the four valuation approaches and their appropriate application

The DCF methodology is widely used to evaluate capital projects. In the DCF approach, the value of the project is the future-expected cash flows discounted at a rate that reflects the risk of the projected cash flows. The DCF methodology is founded on the principle that it is inappropriate to capitalize earnings per se. One must also take into account the investment required to generate those earnings. Consequently, cash flows are obtained by deducting net capital expenditure and incremental working capital investment from net-operating profits after taxes (NOPAT). Since companies are portfolios of projects, the DCF approach is widely used in valuation of firms as well.

S.R. Vishwanath
Institute of Management Technology, 603, Khullar Apartments, Byramji Town, Nagpur 440001, India
e-mail: srvishy@gmail.com

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_10,

10.2 Steps in Valuation

The steps involved in the valuation are as follows:

10.2.1 Step 1: Determine Free Cash Flow

FCF is the cash flow available to all investors in the company – both shareholders and bondholders after consideration for taxes, capital expenditure, and working capital investment.

$$\begin{aligned}\text{Free cash flow} = \text{NOPAT} + \text{depreciation} - \text{capital expenditure} - (+)\\ \text{increases (decreases) in working capital investment,}\end{aligned}$$

where

$$\begin{aligned}\text{NOPAT} &= \text{Net Operating Profit after tax} = \text{Earnings before Interest but after Taxes,}\\ &= \text{EBIT}(1 - \text{Tax rate}),\\ \text{EBIT} &= \text{Revenue} - \text{cost of goods sold} - \text{operating expenses} - \text{depreciation.}\end{aligned}$$

Estimation of cash flows requires NOPAT, capital expenditure, and networking capital. In calculating NOPAT, interest is not deducted because the discount rate, weighted average cost of capital (WACC), incorporates after-tax cost of debt.

10.2.1.1 Capital Investments

The physical assets of a company depreciate and need to be replaced to maintain a certain level of growth in sales. Usually, Capex is estimated as a constant percentage of revenues. Capex can be either positive or negative depending on whether the company is making or liquidating investments. If Capex is negative, it is a source of funds. To gain an estimate of capital investment required per dollar of sales increase, take the sum of all capital investments less depreciated over the last 5–10 years in similar project and divide this total by the sales increase from the beginning to the end of the period.

10.2.1.2 Working Capital Investment

Apart from investment in fixed assets, a firm will have to invest in current assets like inventory and book debts for day-to-day running of the business. Part of current assets can be funded by noninterest-bearing current liabilities, like accounts payable and salaries and wages payable. The excess of current assets over current liabilities, which is to be funded by other sources, is called networking capital. Often, executives either ignore or understate working capital investment. When sales rise, accounts receivable and inventory also rise, which, if not taken into account, results in overstatement of working capital. Usually, the spontaneous rise in accounts payable and other accrued liabilities will not cover the increase in current assets. The gap comes from new debt, which increases risk. As a rough estimate, working capital can be expressed as a function of the level of activity, that is, number of units sold or sales revenue. To illustrate, working capital for a company may be 15% of revenues.

The working capital investment should not include cash and other equivalents. That is, noncash working capital is to be taken into consideration. FCFs thus obtained can be either positive or negative depending on whether the business is generating a surplus or a deficit under a specific plan of growth. Due care must be taken in estimating working capital investment. Actual year-to-year balance-sheet changes often do not reflect the average or normal needs of the business during the year.

Operating working capital is defined as

$$\begin{aligned}&\text{Transaction cash balance} + \text{accounts receivable} + \text{inventory} + \text{other current assets}\\&\qquad - \text{accounts payable} - \text{taxes payable} - \text{other current liabilities},\end{aligned}$$

$$\mathrm{CF}_t = \text{Cash flow in year}\, t = S_{t-1}(1+g_t)(p_t)(1-T) - (S_t - S_{t-1})(C_t + W_t),$$

where

S = sales,
P = profit margin = EBIT as a percentage of sales,
T = income tax rate,
C = capital Investment required (net of depreciation) per rupee of sales increase,
W = net working capital per rupee of sales increase, and
g = growth rate

10.2.1.3 Impact of Depreciation

$$\begin{aligned}\text{Cash flow} &= \text{EBIT} - \text{Tax on EBIT} + \text{Depreciation} - \text{capital expenditure} - (+)\\&\qquad \text{increase (decrease) in working capital.}\end{aligned}$$

Value of the firm or equity is a function of cash flows and cash flow is a function of depreciation. The higher the depreciation, the higher is the cash flow and hence value; other things remaining constant.

Assume the following data for a project or a firm.

Initial investment = $4,500
Project life = 4 years
Salvage value = 0
Discount rate = 15%

	1	2	3	4
EBIT	1,000	2,000	3,000	4,000
−Tax @ 35%	350	700	1,050	1,400
+Depreciation	1,125	1,125	1,125	1,125
CF	1,775	2,425	3,025	3,725

$$\text{Net Present Value} = -4,500 + \text{PV of cash flows} = \$2,998.70$$

If the method of depreciation were to be changed to the written-down value method

	1	2	3	4
EBIT	1,000	2,000	3,000	4,000
−Tax @ 35%	350	700	1,050	1,400
+Depreciation at 33.3% of written down value (WDV)	1,500	1,000	667	444
Cash flow	2,150	2,300	2,617	3,044

$$\begin{aligned}\text{NPV} &= -4,500 + \text{PV of cash flows},\\ &= \$2,572.\end{aligned}$$

The total amount of depreciation might be the same in both the cases, but there is a timing difference. In the second case, more depreciation is provided in the initial years. This results in a change in value.

10.2.1.4 Steps Involved in the Estimation of Cash Flows

Estimate the most likely incremental cash flows to be generated by the firm. Note that financing is not incorporated in the cash flows. Suitable adjustments for the specific financing will be made in the discount rate.

$$\text{CF}_t = \text{Cash flow in year } t = S_{t-1}(1+g_t)(p_t)(1-T) - (S_t - S_{t-1})(C_t + W_t).$$

The forecast of FCFs requires the following inputs:

1. Initial sales before the starting of the forecast period.
2. Growth rate in sales for the entire forecast period. The growth rate may remain constant or change.
3. The ratio of EBIT/sales (profit margin) for the entire period.
4. The ratio of total operating capital (i.e., Capex + working capital investment) to sales for the period.

Thus,

$$\text{Sales}_t = \text{Sales}_{t-1} \times (1 + g_t),$$

$$\text{EBIT}_t = \text{Sales}_t (p_t),$$

$$\text{Asset Requirement} = \text{a}_t = [(\text{FA} + \text{WC})/S]_t,$$

$$(\text{FA} + \text{WC})_t = \text{Sales}_t \times [(\text{FA} + \text{WC})/S]_t.$$

10.2.2 Step 2: Estimate a Suitable Discount Rate for the Firm

An analyst can use the WACC based on the company's target capital structure only if the firm is listed. If the firm is unlisted and has a different capital structure than other comparable firms in the industry or the industry average, suitable adjustments to the discount rate have to be made. The discount rate should reflect the capital structure of the firm. To calculate the discount rate

- Estimate the asset beta for the firm using the relationship $\beta_A = \beta_E(E/V)$, where E/V is the equity-to-value ratio and β_{E} is the equity beta. The asset beta may be obtained by taking the average asset betas of comparable firms in the industry.
- Relever the asset beta at the target debt ratio (say, 30% using the same relationship and find levered equity beta for the firm in question.
- Estimate the cost of equity using the capital asset pricing model (CAPM)
- Similarly, estimate the cost of debt
- Calculate WACC as the weighted average of costs of debt and equity, the weights being target, market value debt-to-value and equity-to-value ratios, respectively.

10.2.3 Step 3: Calculate the Present Value of Cash Flows

Since the firm is usually a going concern,

$$\text{Value of the firm} = \text{PV of cash flows during the forecast period} + \text{Terminal value}$$

We can set the forecast period in such a way that the firm reaches a stable phase after that. In other words, we are assuming that the firm will grow at a constant rate after the forecast period. The period of high growth can be anywhere from 3 to 20 years (may be even more for some computer software firms) depending on the type of business, size of the market, entry barriers, availability of substitutes, number of players in the market, and so on.

10.2.4 Step 4: Estimate the Terminal Value

The terminal value is the present value of cash flows occurring after the forecast period. If we assume that cash flows grow at a constant rate after the forecast period, the terminal value

$$\mathrm{TV} = \frac{[\mathrm{CF}_t(1+g)]}{k-g},$$

where CF_t = cash flow in the last year, g = constant growth rate, K = discount rate

Step 5: Add present value of terminal value to arrive at firm value
Step 6: Deduct the current book value of debt to arrive at value of equity
Step 7: Divide the value of equity by the number of shares to arrive at value per share
Step 8: Compare the intrinsic value with the prevailing stock price to make buy or sell decision.

10.2.5 An Illustration

The forecast of FCF for a company is shown in Exhibit 10.1. The analyst expects the company to grow at 15% per annum. The cost of capital for the firm is 14.62%. The present value of cash flows amounts to \$39.09 million, assuming that the company will not achieve any operating improvements or make changes in the capital structure. The cash flows are expected to grow at 10% forever after year eight.

$$\text{PV of Free Cash Flow during forecast period} = \$\,39.09\,\text{million}$$

$$\text{Enterprise Value} = \text{Value of the company during forecast period} + \text{terminal value}$$

Exhibit 10.1 Free cash flow *(FCF)* forecast

	Years (in \$ m)							
	1	2	3	4	5	6	7	8
Sales	162.13	204.69	235.39	270.7	311.31	358.01	411.71	473.46
NOPAT	10.62	11.22	11.72	12.72	14.41	16.21	18.13	20.11
+ Depreciation	2.13	2.68	2.82	2.96	3.11	3.26	3.42	
Less: 3.14								
Capital exp.	0	0.63	2.36	1.79	1.	1.97	2.07	2.17
Increase in W.C.	0	6.44	4.12	6.10	9.45	11.67	12.97	14.32
Free cash flow \$	13.76	6.28	7.37	7.65	6.04	5.68	6.35	7.04

10.3 Estimating Terminal Value

10.3.1 Approach 1: Terminal Value is a Growing Perpetuity

$$\begin{aligned}\text{Terminal value} &= \text{FCF}_t \frac{(1+g)}{(k-g)},\\ &= 7.04 \frac{(1.10)}{(0.1462-0.10)},\\ &= \$167.6\,\text{million}.\end{aligned}$$

$$\begin{aligned}\text{Present value of terminal value} &= 167.6 \times \text{Present Value Interest Factor}\\ &\qquad (14.62\%, 7\,\text{years})\\ &= 167.6 \times 0.384 = \$64.46\,\text{million}.\end{aligned}$$

$$\text{Total Value} = \$(39.06 + 64.46)\,\text{million} = \$103.52\,\text{million}.$$

Since we are interested in buying only the shares of the firm, the value of outstanding debt should be deducted from the firm value to arrive at the value of equity. Assume that the company has debt amounting to \$7.92 million.

$$\text{Value of equity} = 103.52 - 7.92 = \$95.60\,\text{million}.$$

As is evident, much of the target company's value comes from terminal value, which is sensitive to the assumption made about the growth rate of cash flows in perpetuity. There are three other ways in which terminal value can be estimated.

10.3.2 Approach 2: Terminal Value is a Stable Perpetuity

If there is no capital expenditure or capital expenditure exactly equals depreciation after the forecast period, meaning that the total capital does not grow anymore, cash flow equals profit after tax. In other words, when we assume that the company earns a rate of return on capital equal to the cost of capital irrespective of growth in sales,

$$\begin{aligned}\text{Terminal Value} &= \left[\frac{\text{Free cash flow}}{\text{Discount rate}}\right] = \frac{\text{FCF}}{k},\\ &= \left[\frac{7.04}{0.1462}\right] = \$48.15\,\text{million}.\end{aligned}$$

Value of the firm $= 39.09 + 48.15 = \$87.24$ million. The difference in value is almost \$ 16.28 million.

10.3.3 Approach 3: Terminal Value as a Multiple of Book Value

The terminal value can also be estimated by multiplying the forecasted book value of capital by an appropriate market-to-book ratio (P/BV). Normally, the current M/B ratio is taken as proxy for future.

Consider the following example:

	Market value	Book value	*M/B* (in $ million)
Debt	8.0	8.0	1.0
Equity	15.0	10.0	1.50
Total capital	23.0	18	1.28

The current *M/B* ratio is 1.28. If the book value of capital at the end of forecast period is $ 30 million, terminal value $= 30 \times 1.28 = \$\,38.40$ million.

10.3.4 Approach 4: Terminal Value as a Multiple of Earnings

The terminal value under this method is established by multiplying the forecasted terminal year profits by an appropriate Price–Earning multiple. As usual, the current *P/E* multiple can be used as proxy for future.

$$\text{Current } P/E \text{ multiple} = \frac{\text{Current market value of company}}{\text{Current profit after tax}}.$$

To illustrate, if the current market Capitalization is $ 57.62 million and profit after tax is $ 8.23 million, $P/E = 57.62/8.23 = 7$

$$\text{Terminal value} = \text{Last year profits} \times P/E \text{ multiple}.$$

If the last year profits are $ 20.11 million,

$$= \$\,20.11 \times 7 = \$\,140.8 \text{ million}.$$

Obviously, the method adopted affects the final value placed on the company's equity. These four methods might give four different answers. The DCF approach can capture the value of assets in place. It does not capture the value of future growth opportunities.

A sensitivity analysis may be conducted for pessimistic and optimistic values of key financial variables like sales growth rate, profit margin, working capital investment, capital expenditure, period of high growth, etc. The end product of such an analysis is a range of prices within which the stock price may lie.

To sum up, valuation has three elements: estimation of cash flows, estimation of discount rate, and sensitivity analysis.

10.4 Adjusted Present Value

Discounting FCF at WACC works reasonably well when the company targets a constant debt to value ratio. The corporate WACC used in many valuations is based on the assumption that the cash flows of the target (in case of acquisitions) are about as risky as that of the acquiring company, and the target company will maintain a similar capital structure as that of the acquiring company (in case of acquisitions). Both are restrictive assumptions.

The APV approach is a good alternative when companies target an absolute amount of debt. A transaction can be treated as though it is all equity financed and then this base case value can be adjusted to account for financing effects like interest tax shield, bankruptcy costs, etc.

APV unbundles all the components of Net Present Value, the end result of FCF/WACC valuation, and analyses each one separately where as WACC bundles all financing side effects into the discount rate.

$$\begin{aligned} \text{APV} &= \text{Base case value} + / - \text{value of financing side effects,} \\ \text{APV} &= \text{Value of project/firm if all equity financed} + \text{Present Value of interest tax} \\ &\quad \text{shields} - \text{Present Value of bankruptcy costs.} \end{aligned}$$

The first step in calculating APV requires the calculation of present value of a company's cash flows assuming all equity financing.

Consider a hypothetical example. The cash flows of a company are given below.

Year (1)	NOPAT (2)	Capital exp (3)	Dep. (4)	$\Delta W.C$ (5)	($ million) Net cash flow (6) = 2+4−3−5
1.	60	30	20	20	30
2.	70	32	22	22	38
3.	75	35	24	23	41
4.	80	37	26	25	44
5.	85	40	28	27	46

Cash flows are expected to grow at 7% forever thereafter.

$$\text{PV of terminal value} = \frac{46(1.07)}{(k-0.07)(1+k)^5}.$$

The unlevered value is obtained by discounting all the cash flows at the *unlevered* cost of equity

$$= R_{\mathrm{f}} + \beta_{\mathrm{u}} \text{ (risk premium)},$$

where β_{u} = unlevered beta or asset beta.

The asset beta is the weighted average of betas of debt and equity. That is,

$$\beta_{\mathrm{A}} = \beta_{\mathrm{D}}(D/V) + \beta_{\mathrm{E}}\left(\frac{E}{V}\right).$$

If we assume that the beta of debt is zero,

$$\beta_{\mathrm{A}} = \beta_{\mathrm{E}}\left(\frac{E}{V}\right).$$

A problem arises when the company is unlisted. Since unlisted companies, by definition, do not have stock market data, one cannot estimate either equity or asset betas directly. One can, however, estimate asset beta by looking at comparable companies. Assume that an unlisted company has 4 "comparable" firms in the same industry group (similar line of business and size). Their betas and D/E ratios are given below:

Firm	Beta	D/E
1	1.0	0.50
2	0.6	0.0
3	0.8	0.4
4	0.9	0.45

Company 2 has no debt. The cost of equity for this company can be taken as proxy.

Assume the following CAPM parameters:

$R_f = 7\%$,[1] $\beta_{\mathrm{A}} = 0.60$, market premium $= 7.5\%$
Cost of unlevered equity $= 7 + 0.60(7.5) = 11.5\%$,

$$\text{The PV of cash flows} = [30 \times \text{PVIF}(11.5\%, 1) + \cdots\cdots + 46 \times \text{PVIF}(11.5\%, 5) \\ + \text{Present value of terminal value}].$$

PV of cash flows during forecast period $= \$142.62$ million

$$\text{Terminal value} = \frac{46\,(1.07)}{(0.115 - 0.07)} = \$1093.77\,\text{million},$$
$$\text{PV of terminal value} = \frac{1{,}093}{(1.15)^5} = \$\,543.80\,\text{million},$$
$$\text{All equity value} = \$\,142.62 + 543.80\,\text{million} = \$\,686.40\,\text{million}.$$

The acquisition price (in case of acquisition) of \$ 600 million will be financed with \$ 300 of debt. It will be brought down to \$ 200 million in 5 years. The indebtedness is expected to remain at that level forever.

[1] 10 year T-Bond rate, say.

End of year	Debt ($ million)
0	300
1	280
2	260
3	240
4	220
5	200

$$\text{Present value of interest tax shields} = \text{PV of tax shields during the first 5 years} + \text{PV of perpetual tax shields after year five.}$$

$$\text{Tax shield} = \text{interest rate} \times \text{amount of debt outstanding} \times \text{tax rate.}$$

Assume a tax rate of 35% and interest rate of 14%.

$$\begin{aligned}\text{PV of tax shield during first 5 years} &= [0.14 \times 300 \times 0.35 \times \text{PVIF}(14,1)] \\ &\quad + \cdots + 0.14 \times 220 \times 0.35 \times \text{PVIF}(14,5) \\ &= \$44.89\,\text{million}\end{aligned}$$

$$\begin{aligned}\text{Terminal value of tax shields} &= \frac{0.14 \times 200 \times 0.35}{0.14(1.14)^5} \\ &= \$36.84\,\text{million}\end{aligned}$$

The cost of debt is used as discount rate on the assumption that tax shields are about as uncertain as debt payments generating them. If tax shields are considered riskier than interest payments, a higher rate may be used.

$$\text{Present value of tax shields} = 44.89 + 36.84\,\text{million} = \$81.73\,\text{million},$$

$$\text{APV} = \text{Base case value} + \text{PV of tax shield} - \text{Acquisition price},$$

$$\text{APV} = \$686.40 + 81.73 - 600\,\text{million} = \$768.13 - 600 = \$168.13\,\text{million}.$$

Adjustment for incremental bankruptcy cost can be made either subjectively or taking suitable proxies. The acquisition price of $ 600 million compares well with the base case value ($ 686 million). An acquirer should look for making money from incremental improvements in operations rather than good financing. If tax shields evaporate or bankruptcy cost exceeds tax shields, the value will never be realized.

Another example is given below.

Asset beta	0.7
Risk free rate	6.00%
Risk premium	7.80%
Discount rate	11.46%
Long-term rate	5.00%
Starting debt	$150
Debt interest rate	8.00%
Tax loss carry forward	$50

Year	2005	2006	2007
EBIT	100	134	134
Tax @ 40%	40	54	54
NOPAT	60	80	80
Capital expenditure	30	40	40
Depreciation	20	28	28
Change in working cap	20	27	27
FCF	30	39	39
Net present value of cash flows	87		
Net present value of perpetuity	515		
NPV cash flows + perpetuity	603		
Interest	12	10	8
After tax interest	35	50	51
Ending debt	127	94	59
Tax shield value	5	4	3
Additional tax shield discounted value	10		
Tax loss carry forward	35	15	0
Tax loss carry forward discounted value	45		
APV	658		

10.5 Valuation of Equity Cash Flows

To arrive at cash flows interest charges are not deducted although they are real. The reason is that the discount rate (WACC) already considers debt financing. WACC is calculated by taking weighted average after-tax costs of equity and debt. The cost of debt in the WACC formula already accounts for project specific debt financing. Deducting interest from EBIT would lead to double counting.

$$\text{WACC} = K_{\text{d}}(1-T)(D/D+E) + K_{\text{e}}(E/D+E).$$

A firm can be analyzed from the perspective of all investors or just equity investors. In the former case, the cash flows do not consider interest charges and the discount rate is the WACC. While analyzing from the equity investors' perspective some changes need to be made. The initial investment would be equity investment and not total investment; the discount rate would be the cost of equity and the cash flow would be the residual cash flow to equity investors.

$$\begin{aligned}\text{Cash flow to equity} = {} & \text{EBIT} - \text{Tax} + \text{Depreciation} - \text{Capital Expenditure} \\ & - \text{Increase in working capital} - \text{After tax interest payment} \\ & - \text{principal repayment} + \text{New Borrowing.}\end{aligned}$$

Cash flow to equity is the residual cash flow after meeting investment requirements and contractual payments. It should be noted that cash flow to equity is more meaningful for a growing firm that borrows all the time to invest. For a typical growing firm cash flow from operations would be negative.

Valuing equity cash flows would be more meaningful when leverage is high and changes dramatically from year to year. The usage of constant discount rate (i.e., WACC) in the FCF valuation gives erroneous answers. When leverage changes the risk of cash flows also changes. So we would expect the discount rate to increase whenever leverage increased and decrease whenever leverage falls. In case of high leverage transactions like Project Finance or Leveraged Buyout leverage increases from 0% to about 60–90% and then again falls back to 0 or more normal levels. The FCF to firm approach is cumbersome to implement because both the cost of debt and cost of equity have to be recalculated in each year. Under the equity cash flow valuation the cost of equity has to be recalculated in each year using the estimates of equity beta in each year according to the formula:

$$\beta_{\mathrm{A}} = \beta_{\mathrm{E}}\left(\frac{E}{V}\right).$$

This estimate of equity beta can be plugged into the CAPM to arrive at the cost of equity.

It should be noted that the estimate of asset beta itself is constant as it depends on business risk and not financial risk.

The assets (i.e., firm value) minus debt (equals equity value) approach to estimation of equity value works well when debt is fairly priced. In a LBO situation it is difficult to estimate the value of debt because of high probability of financial distress. Consequently, the equity value could be erroneous. Valuing equity directly would be more appropriate.

10.5.1 An Illustration

Clariant is in the process of purchasing Synergon. Forecasting cash flows for Synergon under Clariant's management involves suitable assumptions regarding sales growth rate, profit margin, capital expenditure, and net working capital for every dollar of sales increase. The relevant assumptions for the forecast period are given below.[2]

---

[2] This methodology was introduced by Rappaport in Rappaport, Alfred, "Strategic Analysis for Profitable Acquisitions," Harvard Business Review, July–August, 1979. Also see Rappaport,

	Years	
	1–5	6–10
Sales growth rate, g%	15	10
Profit margin, EBIT/sales, %	0.18	0.15
Tax rate %	36	36
Capex per dollar of sales increase (C)[3]	0.30	0.15
Working capital per dollar of sales increase (W)	0.15	0.10

Exhibit 10.2 Recent financial statements of Synergon

Income statement	(in \$ m)
	Synergon
Sales	350
EBIT	32.16
Interest @ 12 %	12.86
Net income	24.12
No. of shares outstanding (m)	16.08
Balance sheet	
Debt	107.20
Equity	160.80
	268.00
Fixed assets	
Less: Accumulated Depreciation	216.00
Net working capital	50.00
Other assets	2.00
	268.00
WACC	12%

The company's value is expected to be stable after the forecast period when the company enters a stable phase. The current financial details of Synergon are given in Exhibit 10.2.

The cash flow in any year $= CF_t = S_{t-1}(1+g_t)(p_t)(1-T_c) - (S_t - S_{t-1})(C_t + W_t)$,

where $p = \text{EBIT}/\text{sales}$, $S = \text{sales}$, $T_c = \text{tax rate}$

Alfred, Creating Shareholder Value: The New Standard for Business Performance, The Free Press, 1986.

[3] Net of depreciation.

Exhibit 10.3 Forecast of cash flows for Synergon ($ million)

Year	Sales	EBIT	Pt	NOPAT	St-St-1	C+W	Capex+W.C	FCF	PV-factor	PV
0	350									
1	402.5	72.45	0.18	46.368	52.5	0.45	23.625	22.743	0.893	20.309499
2	462.875	83.31	0.18	53.3184	60.375	0.45	27.16875	26.14965	0.797	20.84127105
3	532.3	95.8	0.18	61.312	69.425	0.45	31.24125	30.07075	0.712	21.410374
4	612.15	110.18	0.18	70.5152	79.85	0.45	35.9325	34.5827	0.636	21.9945972
5	703.97	126.71	0.18	81.0944	91.82	0.45	41.319	39.7754	0.567	22.5526518
6	774.37	116.15	0.15	74.336	70.4	0.25	17.6	56.736	0.507	28.765152
7	851.8	127.77	0.15	81.7728	77.43	0.25	19.3575	62.4153	0.452	28.2117156
8	937	140.55	0.15	89.952	85.2	0.25	21.3	68.652	0.404	27.735408
9	1030.7	154.6	0.15	98.944	93.7	0.25	23.425	75.519	0.361	27.262359
10	1133.75	170	0.15	108.8	103.05	0.25	25.7625	83.0375	0.322	26.738075
									Total	245.8211027

$$\begin{aligned}\text{Thus, cash flow in year}\,1 &= 350(1+0.15)(0.18)(1-0.36)-(402.50-350)\\ &\quad\times(0.30+0.15)=\$46.368-23.625\,\text{million}\\ &=\$22.743\,\text{million}.\end{aligned}$$

The projections for the first 10 years are shown in Exhibit 10.3.[4] Assume that the WACC for the company based on a long run capital structure is 12%.

If we assume that the company generates normal returns from year 10, that is, the company's value is unaffected by growth, the terminal value can be estimated as a perpetuity.

$$\text{Terminal Value} = \frac{\text{FCF}_{10}}{\text{Discount rate}} = \frac{83.03}{0.12} = \$691.90\,\text{million},$$

$$\text{PV of terminal Value} = \text{TV} \times \left[\frac{1}{(1+k)^{10}}\right] = \$171.26\,\text{million}$$

Total Present value i.e. Firm Value $ million	
– Synergon's Debt Assumed $ million	317.08 – 107.2
Value of Synergon's Equity $ m	209.88
Value/Share $	13.05.

Clariant may pay a price higher than $13.05 if cash flows can be enhanced for the same level of investment or reduce investment for the same level of cash flows.

[4] The sales growth rate and the assumptions regarding margins, capex, and working capital investment are usually extrapolated from the current year (as base year) based on the assumption that current year is a normal year. One might take the average of past 2 or 3 years if there is a reason to believe that current year is too good or too bad so that the trend is not unrealistic.

10.6 Capital Cash Flow Valuation

In FCF valuation the WACC is used to discount cash flows. An algebraically equivalent, yet superior, method is the CCF valuation (Ruback 2000). FCF valuation excludes interest tax shields because the discount rate, WACC, incorporates the tax advantage of debt. In CCF valuation, FCF plus interest tax shields are discounted at *Pre-tax* WACC (i.e., expected asset return). Since the asset return does not change when capital structure changes, it is easier to implement CCF valuation.

$$\begin{aligned}\text{Capital Cash flow} = {} & \text{Net Income} + \text{Depreciation} - \text{Capital Expenditure} \\ & - \text{Working Capital} + \text{Cash Interest},\end{aligned}$$

or

$$\begin{aligned}= {} & \text{EBIT}(1-T) + \text{Depreciation} - \text{Capital Expenditure} - \text{Working Capital} \\ & + \text{Interest Tax Shields}.\end{aligned}$$

It is easier to implement the former approach because it incorporates corporate estimates of taxes that reflect the special circumstances facing the firm rather than mechanically finding the product of tax rate and taxable income.[5]

The appropriate discount rate is a before tax rate because the tax benefits of debt are already included in the CCFs. The correct discount rate is the pretax WACC.

$$\text{Pre tax WACC} = \text{Weighted average costs of debt and equity} = \left(\frac{D}{V}\right) K_{\mathrm{D}} + \left(\frac{E}{V}\right) K_{\mathrm{E}},$$

D/V and E/V are debt-to-value and equity-to-value ratio, respectively; K_{D} and K_{E} are costs of debt and equity.

$$\text{Cost of debt} = K_{\mathrm{D}} = R_{\mathrm{f}} + \beta_{\mathrm{D}}\ (\text{risk premium}),$$

$$\begin{aligned}\text{Cost of equity} &= K_{\mathrm{E}} = R_{\mathrm{f}} + \beta_{\mathrm{E}}\ (\text{risk premium}),\\ \text{Pre-Tax WACC} &= \frac{D}{V}(R_{\mathrm{f}} + \beta_{\mathrm{D}} \times R_{\mathrm{P}}) + \left(R_f + \frac{E}{V}\beta_{\mathrm{E}} \times R_{\mathrm{P}}\right),\\ &= R_f + \left(\frac{D}{V}\beta_{\mathrm{D}} + \frac{E}{V}\beta_{\mathrm{E}}\right) R_{\mathrm{P}},\\ &= R_f + \beta_{\mathrm{A}}(R_{\mathrm{P}}).\end{aligned}$$

Since $\quad \beta_{\mathrm{A}}\mathrm{V} = \beta_{\mathrm{D}} D + \beta_{\mathrm{E}} E,$

or $\quad \beta_{\mathrm{A}} = \beta_{\mathrm{D}}\frac{D}{V} + \beta_{\mathrm{E}}\frac{E}{V}.$

[5] In other words, in many instances it does not reflect the actual tax paid.

Note that the discount rate depends on R_f, β_A, and risk premium and does not incorporate D/V or E/V. That is, the pretax WACC is independent of capital structure and, hence, can be applied to all cash flows regardless of the capital structure in existence. In other words, pretax WACC, which is a function of asset beta, is constant. Both FCF valuation and CCF valuation provide the same answer. CCF valuation, however, is easier to implement.

The CCF valuation methodology is especially appropriate when the company in question is being restructured and has high leverage and complicated tax status resulting from net-operating losses (NOLs), which is usually true of bankrupt firms. In a restructuring situation all concerned parties would be interested in estimating the value of their claim after the transaction. Typically, creditors get equity in exchange for debt; promoters (majority shareholders) invest equity to keep the company alive. So they would be interested in estimating the value of equity after the transaction. To get an estimate one should forecast CCF and discount it using pretax WACC. The terminal value is calculated assuming that CCFs grow at a constant rate in perpetuity, starting with the last year of the projections. Many bankrupt firms will have unused NOL carry forwards at the end of the projection period. These NOLs are not forecasted to continue in perpetuity (Gilson et al. 2000). Therefore, the terminal value is estimated in two parts. The first part extends the financial projections and simulates a firm's use of NOLs until the NOLs are used up or expire. During this extended projection period, CCFs are calculated as:

$$\begin{aligned}(&[\text{EBIT} - \text{interest}) \times \text{tax rate}] + \text{Cash flow adjustments} + \\ &\text{tax shield due to NOLs} = \text{capital cash flows}.\end{aligned}$$

In the second part of the terminal value calculation the value of firm is estimated as a growing perpetuity of CCF in the year following the extended forecast period. This cash flow does not include any NOL benefits. The present value of this portion of the terminal value is added to the present value of the CCFs during the extended forecast period to estimate the total terminal value.

The result of this exercise is the value of the *firm*. Subtracting the value of post-transaction debt yields the value of equity.[6]

10.6.1 An Illustration

Assume that the company being valued has the following characteristics:

$$\begin{aligned}&\text{Asset beta} &&= 1\\ &\text{Debt beta} &&= 0.25\\ &\text{Risk free rate} &&= 8\%\\ &\text{Risk premium} &&= 10\%\end{aligned}$$

[6] One may also use the adjusted present value methodology to value the firm.

Year	0	1	2	3
Debt (%)	60	50	40	30
Equity (%)	40	50	60	70
Pretax cost of debt (%) ($R_f + \beta_D \times R_P$)	10.5	10.5	10.5	10.5
Equity beta[7]	2.5	2.0	1.66	1.43
Cost of equity (%) (Using CAPM $R_f + \beta_E \times R_P$)	33	28	24.6	22.3
Pretax WACC	19.5	16.45	18.96	18.76

These discount rates are used to value the CCFs estimated using the formula given above.

10.7 Concluding Comments

Valuation is both an art as well as a science. This chapter highlighted some valuation approaches in different settings like acquisitions corporate restructuring, etc. An analyst can construct his or her own framework to suit the individual circumstances facing the firm. The length of the forecast horizon, choice of the model, and discount rates are some of the generic issues that analysts face. Many analysts supplement the DCF methods with other approaches, like multiples valuation and real options analysis. These are discussed in the subsequent chapters.

10.8 End of the Chapter Questions and Exercises

1. Explain the rationale for DCFs rather than profits in valuation.
2. Why is interest expense not included in the estimation of cash flows even though it is real expense? Where else is it accounted for?
3. How is the APV method different from FCF/WACC approach? When does APV work better?
4. In the APV method interest tax shields are discounted at pretax cost of debt. What is the assumption one would be making if one were to use after-tax cost of debt?
5. Similarly, why are FCFs discounted cost of unlevered equity (in the APV method)?
6. Between the two methods – FCF/WACC and APV – which method gives a higher estimate of value?
7. How is CCF valuation different from FCF/WACC approach?
8. Between CCF and APV, which method gives a higher estimate of value?

[7] Equity beta = (asset beta /% of equity).

9. Refer to the data given below.

Assumptions	Asset beta	0.7
	Risk free	6.00%
	Risk premium	7.80%
	Discount rate	11.46%
	Long-term rate	500%
	Starting debt	$150
	Debt interest rate	8.00%
	Tax loss carry forward	$50

Year		1998	1999	2000
Earnings before interest and taxes		100	134	134
Tax EBIT at rate of	40.00%	40	54	54
Profit after tax		60	80	80
Capital expenditures		30	40	40
Depreciation		20	28	28
Change in working capital		20	27	27
FCF (net cash flow)		30	39	39
Interest		12	10	8
Tax after interest		35	50	51
Profit after tax and interest		53	74	76
FCF (net cash flow) after interest		23	33	35
Ending debt		127	94	59

Calculate APV.

10. Refer to the data given below.

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5 = n
Panel A – inputs for present value calculations						
1. Net revenues ($)	5,000	5,400	5,832	6,299	6,802	7,347
2. Revenue growth rate (%)		8.0	8.0	8.0	8.0	8.0
3. NOI = EBIT ($)	500	540	583	630	680	735
4. Cash tax rate (T) (%)	40.0	40.0	40.0	40.0	40.0	40.0
5. Income taxes	200	216	233	252	272	294
6. NOPAT ($)	300	324	350	378	408	441
7. +Depreciation	250	270	292	315	340	367
8. −Change in working capital	50	54	58	63	68	73
9. −Capital expenditures	100	108	117	126	136	147
10. −Change in other assets net	50	54	58	63	68	73
11. FCFs ($)	350	378	408	441	476	514
12. Interest expense ($)		400	380	300	200	150
13. Interest tax shield ($)		160	152	120	80	60

Assume

(a) Risk-free rate (R_{f})	6.00%
(b) Asset beta (β_{a})	0.723
(c) Risk premium (RP)	6.50%

Assume that the cash flows grow at 3% in perpetuity. Calculate CCFs and the value of the company.

Reference

Ruback RS (2000) Capital cash flows: a simple approach to valuing risky cash flows. Working Paper, Harvard Business School

Chapter 11
Valuation Using Multiples

S.R. Vishwanath

11.1 Chapter Introduction and Objectives

In addition to discounted cash flow (DCF) analysis, analysts, and investors commonly use valuation multiples to come up with the "relative value" of a company. That is, valuation multiples are used to estimate relative under or over valuation. This chapter provides an overview of some of the popular multiples.

This chapter has the following objectives:

- Discuss valuation multiples like price-to-earnings (P/E), price-to-book (P/B), price earnings growth (PEG), etc.
- Highlight the limitations of multiples
- Discuss the use of yield based measures in constructing investment strategies

11.2 Introduction

In the last chapter, we demonstrated how an analyst can estimate the intrinsic value of a firm using DCF methods like the Free Cash Flow to Firm approach, the Adjusted Present Value method, and the Capital Cash flow methods. Quite often analysts are also interested in knowing whether a stock is over or under-valued vis-à-vis the industry or some peer group. The objective of relative valuation is to find out whether a stock is *relatively* over or undervalued but not in an absolute sense. That is, it is quite possible for a stock to be relatively undervalued compared to some benchmarks but over valued when compared to its own intrinsic value as estimated using the DCF methodology.

S.R. Vishwanath
Institute of Management Technology, 603, Khullar Apartments, Byramji Town, Nagpur 440001, India
e-mail: srvishy@gmail.com

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_11,

Exhibit 11.1 Examples of multiples

Market capitalization divided by	Stock price divided by	Enterprise value divided by
Net income	Earnings per share	EBITDA
Net cash flow	Cash flow per share	EBIT
EBIT	Book value Per share	Total assets
	Sales per share	Net fixed assets

Price multiples are a useful way to compare the valuation of a stock over time, against "comparable companies" or the market as a whole. These multiples are a ratio of the stock's current market capitalization to one of its underlying accounting fundamentals such as book value (total owners' equity), sales or net income. Because investors are usually more familiar with share price rather than market capitalization (share price $\times$ shares outstanding) the accounting fundamentals are often converted to a per-share basis when using price multiples. Ratios are very popular with investors because they can be calculated easily, and they are readily available from most financial Web sites and newspapers.

While valuation ratios have become ubiquitous, it is important to recognize their strengths and weaknesses. Valuation ratios are handy tools to have at your disposal for a quick-and-dirty analysis, but they all require a lot of context to be useful.

The most common price multiples are the following:

- $P/E =$ (share price)/(earnings per share). Since earnings are meant to approximate the money available to shareholders, the P/E ratio expresses how much the investor pays for each dollar of earnings. This is the most frequently used price multiple.
- $P/B =$ (share price)/(book value per share). This compares the value of the firm today with the capital provided to the company over time.
- Price to sales $(P/S) =$ (share price)/(sales per share). This ratio can be useful for valuing cyclical companies where earnings tend to be more volatile than sales, or situations in which a firm temporarily has little or no earnings.

Exhibit 11.1 presents some commonly used multiples.

A high multiple indicates that the market is wiling to pay a high price relative to the underlying fundamental value such as earnings. A company may trade at a high multiple because it has high growth prospects and future earnings are expected to be higher than past earnings. A low multiple indicates that that the stock is not valued highly – perhaps it has low growth prospects, high risk or is simply undervalued by the market. Value investors tend to search for companies trading at lower multiples than peer companies.

11.3 Identifying Comparable Companies

The first step in the application of multiples is to select a set of comparable firms. In any industry group a firm would have many peer companies. How should one select a comparable firm? In other words, what makes two firms comparable? To answer this question one has to look at the source of risk and return for the two companies in question. Companies may be matched on the basis of several characteristics like size, leverage, etc. It is important to understand the criterion of comparability differs from one multiple to another. For example, when one is using the P/E multiple, leverage is crucial because two firms may be similar in all respect except the debt ratio. A firm with high debt ratio would have fewer shares, higher earnings per share (EPS) and lower P/E multiple, other things remaining constant.

The normal practice in the United States is to identify all companies with the same three-digit SIC code with available data to estimate multiples.[1] If fewer than five companies are identified one may relax the industry requirement to companies with the same 2-digit SIC code and so on.

11.3.1 The P/E Multiple

P/E is the most popular valuation ratio used by investors. It is the ratio of a stock's market price divided by the EPS for the most recent four quarters. One characteristic of P/E is that accounting earnings are a much better proxy for cash flow (used for valuation) than sales. Moreover, EPS results and estimates about the future are easily available from many sources.

$$\frac{P}{E} = \frac{\text{Market Price of share}}{\text{Earnings per share}}.$$

The P/E ratio shows the number of years' EPS contained in the current share price. In other words, it shows the number of years at current earnings needed to cover the current share price. The P/E ratio measures how much investors are willing to pay for every dollar of a company's earnings. Generally speaking, the higher the P/E ratio, the more investors are willing to pay for a dollar's worth of a company's earnings. The P/E ratio is commonly used to assess the level of confidence investors have in a company. It represents the market's view of a company's growth potential. A high P/E ratio indicates that investors have a high level of confidence in a company's future prospects. By comparing P/E ratios between companies and across business sectors, investors hope to identify undervalued stocks. But while a company with a high P/E ratio relative to its sector may have exciting growth prospects, it might equally be considered to be overvalued depending on prevailing market circumstances. So while P/E can be a useful measure of a company's value, it should also be treated with caution.

P/E ratios vary dramatically between sectors. For example, in the new high-tech economy, we have become accustomed to huge valuations for companies that are making enormous losses.

[1] SIC is standard industrial classification. It indicates the company's type of business. See http://www.sec.gov/info/edgar/siccodes.htm and http://www.siccode.com for details.

While traditionally companies were valued using P/E multiples, it is now becoming commonplace for the market to value companies on the basis of projected turnover (i.e., P/S ratio) even though they may be making major losses. Meanwhile, high-tech companies that are actually making money carry extraordinarily high P/E multiples.

Stocks with high P/Es (typically those with a P/E exceeding 30) usually have greater future growth prospects, while stocks with low P/Es (typically those with a P/E below 15) tend to have lesser future growth prospects. However, a P/E ratio by itself does not say much about a stock's valuation.

The most useful way to use a P/E ratio is to compare it with a certain benchmark. Good benchmarks are the P/E of another company in the same industry, the P/E of the entire market, or the same company's P/E at a different point in time. Each of these approaches has some value.

For example, a company that is trading at a lower P/E than its industry peers could be a good buy, but even firms in the same industry can have very different capital structures, risk levels, and growth rates, all of which affect the P/E ratio. All else equal, a firm that has better growth prospects, lower risk, and lower capital reinvestment needs should be rewarded with a higher P/E ratio.

One can also compare a stock's P/E with the average P/E of the entire market. However, the same limitations of industry comparisons apply to this process as well. The stock one is investigating might be growing faster (or slower) than the average stock, or it might be riskier (or less risky). In general, comparing a company's P/E with those of industry peers or with the market has some value, but one should not rely on these approaches to make final buy or sell decisions.

Comparing a stock's current P/E with its historical P/E ratios can also be of value. This is especially true for stable firms that have not undergone major business shifts. If you find a company that is growing at roughly the same rate with roughly the same business prospects as in the past, but is trading at a lower P/E than its long-term average, you should start getting interested. It's entirely possible that the company's risk level or business outlook has changed, in which case a lower P/E is warranted, but it's also possible that the market is simply pricing the shares at an irrationally low level.

Investors can also construct trading strategies on the basis of P/E multiple. Academic studies conducted in the United States have found that investors have tended to earn larger long-horizon returns when purchasing the market basket of stocks at relatively low P/E multiples. Campbell and Shiller (1988b) report that initial P/E ratios explained as much as 30% of variance of future returns.

11.4 Limitations of the *P/E* Multiple

The P/E ratio also has some important drawbacks. A P/E ratio of 15 does not mean anything by itself; it is neither good nor bad in isolation. The P/E ratio only becomes meaningful with context.

However one has to keep in mind that using P/E ratios only on a relative basis means that one's analysis can be skewed by the benchmark one is using. After all, there will be periods when entire industries will become overvalued. In 2000, for example, an Internet stock with a P/E of 75 might have looked cheap when the rest of its peers had an average P/E of 200. In hindsight, neither the price of the stock nor the benchmark made sense. Being less expensive than a benchmark does not mean something is cheap, because the benchmark itself may be vastly overpriced.

It is important to understand that when working with P/E ratio one has to make sure that the earnings part of the equation makes sense and is representative of a company's recurring profits. A few things can distort the P/E ratio. First, firms that have recently sold off a business can have an artificially inflated "EPS" and a lower P/E as a result.

Second, reported earnings can sometimes be inflated (or depressed) by one-time accounting charges and gains (i.e., extraordinary items like litigation settlements and nonrecurring items like discontinued operations and asset sales). As a result, the P/E ratio can be misleadingly high or low. Further, different companies may follow different accounting rules relating to inventory (LIFO vs FIFO), leases (i.e., operating vs capital), owner's compensation, and capitalization of intangibles.

Third, cyclical firms that go through boom and bust cycles (e.g., auto manufacturers) require a bit more investigation. Although you would typically think of a firm with a very low trailing P/E as cheap, this is precisely the wrong time to buy a cyclical firm because it means earnings have been very high in the recent past, which in turn means they are likely to fall off soon. Likewise, a cyclical stock is going to look the most expensive when its EPS has bottomed and is about to start growing again. Due to this reason analysts sometimes calculate normalized EPS to represent "normal earnings" for the entire business cycle.

Lastly, there are two kinds of P/Es – a *trailing P/E*, which uses the past four quarters' worth of earnings to calculate the ratio, and *forward* (or leading) P/E, which uses analysts' estimates of the next four quarters' earnings to calculate the ratio.

$$\text{Trailing P/E} = \frac{\text{Current price per share}}{\text{Last reported earnings}},$$

$$\text{Leading P/E} = \frac{\text{Current Price per share}}{\text{Estimated next period earnings}}.$$

Because most companies are increasing earnings from year to year, the forward P/E is almost always lower than the trailing P/E, sometimes markedly for firms that are increasing earnings very rapidly. Unfortunately, estimates of future earnings by Wall Street analysts are consistently too optimistic. As a result, buying a stock because its forward P/E is low means counting on that future EPS to materialize in its entirety – and that usually doesn't happen.

11.5 Intrinsic *P/E* Multiple

Given the prevailing market price of stock and the EPS an analyst can compute the P/E multiple and compare it with those of the peer group or the market. Often, one would be interested in making an estimate of the intrinsic value of the multiple.

From the Gordon Dividend Discount Model we know that:

$$P = \frac{D_1}{(k-g)},$$

where $P =$ Stock Price
$D_1 =$ Dividends per share next year
$= D_0(1+g)$, that is, current dividend inflated at a growth rate g
$=$ (Current Earnings $\times$ Payout Ratio)$(1+g)$
$k =$ expected equity return
$g =$ growth rate in earnings and dividends

$$P = \frac{E_0 \times b \times (1+g)}{(k-g)}.$$

That is, the price earnings multiple of a firm is a function of pay out ratio, growth rate in earnings and dividends, and risk (captured in expected returns). The higher the payout ratio, the higher is the price-earnings multiple, all else equal. When companies increase their pay out ratio they invest less in operations (in the absence of outside capital), which leads to a decrease in growth rate. An increase in growth rate (in the denominator) leads to a lower spread between expected return and growth rate, and hence, a higher P/E multiple. Likewise, a decrease in expected return (due to a decrease in risk) leads to a higher P/E multiple. One can estimate the intrinsic value of P/E multiple by plugging in the values of k, g, and b.

11.6 Calculating Normalized Earnings and Diluted EPS

As pointed out earlier the EPS in the denominator in sensitive to the business cycle. An unusually high EPS will result in a lower P/E and vice versa. Analysts adjust P/Es for cyclicality by estimating normalized EPS, which is an estimate of EPS in the middle of the business cycle. Two methods are commonly used to estimate normalized EPS:

- An average of EPS during the most recent business cycle is calculated.
- The average Return on Equity (ROE) during the most recent business cycle is multiplied by the current book value per share.

Further, the EPS needs to be adjusted for potential dilution of earnings arising out of exercise of dilutive securities like convertible bonds, convertible preferred stocks, warrants, stock options etc.[2] A simple capital structure is one that contains only common stock, nonconvertible debt, preferred stock, and no potentially dilutive securities. A complex capital structure contains options, warrants, and convertibles.

All firms must report basic and diluted EPS. Basic EPS is defined as:

$$\text{Basic EPS} = \frac{\text{Net income} - \text{Preferred dividends}}{\text{Weighted average number of common shares outstanding}},$$

where weighted average number of shares = number of shares outstanding during the year weighted by the portion of the year they were outstanding.

Potentially, dilutive securities are included in the diluted EPS calculation in one of two ways. The "if converted" method is used in the case of convertible securities, the treasury method for options and warrants. The method assumes that any security convertible into common stock is converted. Dilutive securities like convertibles, options, and warrants cause the weighted average common shares to change. Further, the numerator also needs to be adjusted as follows to eliminate any effect the convertible security had on the measurement of net income:

- If convertible preferred stock is dilutive the convertible preferred dividends must be added back to the previously calculated income from continuing operations less preferred dividends.
- If convertible bonds are dilutive then the bond's after tax interest expense would not be considered as an interest expense for diluted EPS. Hence, interest expense $(1-t)$ must be added back to the numerator.
- If a dilutive security is issued during the year, the increase in the weighted average number of shares for diluted EPS is based on only the portion of the year the dilutive security was outstanding. Dilutive stock options and warrants increase the number of shares but no adjustment needs to be done to the net income in the numerator. Stock options and warrants are dilutive only when their exercise price is less than the average market price of the stock over the year.

The Treasury Stock method applied to options, warrants, and such other arrangements assumes that the options and warrants are exercised at the beginning of the period (or at time of issuance, if later) and that the hypothetical funds received by the company from the exercise of the options are used to purchase shares of the common stock in the market at the average market price. This reduces the total increase in shares created from the hypothetical exercise of the options into common stock and the net increase in the number of shares outstanding will be the number of shares created by exercising the options less the number of shares repurchased with the proceeds of exercise.

The formula used to calculate the number of net increase in common shares from the potential exercise of stock options or warrants when X (exercise price) $< S$ (market price of stock) is:

[2] The chapter on Investing in Convertible Bonds, Preferred Stocks and Warrants discusses the accounting for convertible in greater detail. Readers may also refer to articles cited in that chapter.

$(S\text{–}X)/S\times$ Number of shares that the options or warrants can be converted into To lustrate, if $S = \$20$, $X = \$15$, and the number of shares upon conversion $=$ $100,000$ Net increase in shares $= 5/20 \times 100{,}000 = 25{,}000$ incremental shares.

Once these adjustments are made, the diluted EPS is calculated as

$$\text{Diluted EPS} = \frac{\text{Adjusted income available for common shares}}{\text{Weighted average common and potential common share}}.$$

Adjusted income $=$ Net income $-$ preferred dividends $+$ dividends on convertible preferred stock $+$ after tax interest on convertible debt

$$\text{Diluted EPS} = \frac{\begin{array}{l}\text{Net income} - \text{preferred dividends}\\ +\text{dividends on convertible preferred stock}\\ +\text{After tax interest on convertible debt}\end{array}}{\begin{array}{l}\text{Weighted average shares} + \text{Shares from conversion of convertible}\\ \quad\text{preferred shares} + \text{Shares from conversion of convertible debt}\\ \quad+\text{shares issuable from stock options}\end{array}}.$$

In case of stock splits and stock dividends, though the proportional ownership is unchanged, find the weighted average for the time period shares were outstanding. The split or dividend is NOT applied to any shares that are issued or repurchased after the dividend or split.

11.7 Predicted *P/E* Multiple

As pointed out earlier, the Gordon model suggests that the price-earnings multiple is a function of pay out ratio, risk, and growth rate. Using such a model would be better than naively comparing P/E multiples across firms and industry groups.

Just the firm's systematic risk (beta) is a function of fundamental variables, and a fundamental beta can be estimated from linear regression, a predicted P/E can be estimated from linear regression of historical P/Es on its fundamental variables, including expected growth and risk. Assume that a firm has a payout ratio of 0.50, a beta of 0.9, and an expected earnings growth rate of 6%. Further, assume that a regression on other firms in the industry peers produces the following regression equation:

$$\text{Predicted}\, P/E = 6.25 + (3.75 \times \text{dividend payout}) + (12.00 \times \text{growth}) - (0.5 \times \text{beta}).$$

Note that the relationship between dividend payout, growth, and P/E is positive whereas the relationship between beta (a measure of risk) and P/E is negative.

Plug the observed values of the firm into the above equation:

$$\begin{aligned}\text{Predicted } P/E &= 6.25 + (3.75 \times 0.50) + (12.00 \times 0.06) - (0.5 \times 0.9),\\ &= 6.25 + 1.875 + 0.72 - 0.45,\\ &= 8.395.\end{aligned}$$

Compare the predicted P/E with the actual to estimate under or over pricing. Of course, it is quite possible that the predicted and the actual P/E multiples may deviate but yet not suggest any over or under valuation because the model may not capture all the relevant variables.

11.8 The PEG Ratio

As an offshoot of the P/E ratio, the PEG measures the relationship between a stock's P/E ratio and its growth rate.

PEG is extremely popular with some investors because it seeks to relate the P/E to a piece of fundamental information – a company's growth rate. On the surface, this makes sense because a firm that is growing faster will be worth more in the future (all else being equal).

$$\text{PEG} = \frac{(\text{Forward P/E Ratio})}{(5 - \text{Year EPS Growth Rate})}.$$

The decision rule in using the PEG ratio is as follows:

A stock is fairly valued if the PEG ratio is equal to 1.

A stock is undervalued if the PEG is less than 1. Therefore, buy the stock.

A stock is overvalued if the PEG ratio is greater than 1. Therefore, sell the stock.

The problem with PEG is that risk and growth often go hand in glove – fast-growing firms tend to be riskier than average. This conflation of risk and growth is why PEG is frequently misused. When one uses a PEG ratio alone to compare companies, one is basically assuming that all growth is equal, generated with the same amount of capital and the same amount of risk.

In other words, the PEG ratio is merely an empirical regularity in the US capital markets: high-growth stocks have P/E ratios approximately equal to the medium-term (3–5 years) EPS growth rate times 100, not grounded in financial theory. Analysts, use this relation regardless of industry, leverage or systematic risk.

Firms that are able to generate growth with less capital should be more valuable, as should firms that take on less risk. Consider two stocks. The first stock is expected to grow at 15% and is trading at 15 times earnings and the second is expected to grow at 15% and is trading at 25 times earnings. On the basis of this information, it would be unwise to invest in the former because it has a lower PEG ratio. One has to consider the capital that each firm needs to invest to generate the expected

Exhibit 11.2 Estimates of PE and PEG for Apple Inc

Growth estimate	Apple	Industry	Sector	S&P 500
Current Qtr. (%)	31.9	1.6	11.9	N/A
Next Qtr. (%)	25.9	8.9	14.9	N/A
This year (%)	42.7	10.4	15.6	N/A
Next year (%)	17.9	22.0	18.8	N/A
Past 5 years (per annum) (%)	55.9	N/A	N/A	N/A
Next 5 years (per annum) (%)	20.0	14.51	14.03	N/A
Price/earnings (avg. for comparison categories)	26.8	19.50	19.12	N/A
PEG ratio (avg. for comparison categories)	1.34	1.34	1.36	N/A

growth, as well as the likelihood that those expectations will actually materialize. Nevertheless, PEG does provide a quick and easy way to estimate the price one is paying for future growth.

An example is in order. Exhibit 11.2 presents the analyst estimate of P/E as well as PEG ratios for Apple Inc., industry, sector, and S&P 500 in 2007.[3]

11.9 The *P/B* Value Ratio

The P/B ratio compares a stock's market price with its book value. At the simplest level, a company is worth the value of its assets minus its liabilities – its "book value." Book value is the amount of money that would be available to shareholders if the company's assets (excluding intangibles such as copyright and patents) were sold at their balance sheet value and all liabilities were paid. For example, if assets equal $ 500 million, while liabilities are $ 300 million, then the company's book value is $ 200 million.

Book value is the equity balance on a firm's balance sheet divided by the number of shares outstanding. Book value is often expressed in terms of book value per share (book value divided by the number of outstanding shares). The market price per share is then compared to the book value per share. Conservative investors often prefer the P/B ratio, because it offers a more tangible measure of a company's value than earnings do. Legendary investor Benjamin Graham was a big advocate of book value and P/B in valuing stocks.

The P/B multiple is calculated as:

$$\text{Price-to-book value ratio} = \frac{\text{Market Price per share}}{\text{Book Value per Share}}.$$

[3] http://finance.yahoo.com/q/ae?s = aapl accessed on March 16, 2007.

11.10 Limitations of the *P/B* Multiple

There are caveats to using P/B, just as there are for all the other simple ratios. A major drawback with book value is that it is difficult to value assets accurately. There are a variety of legitimate accounting techniques for measuring tangible assets, all of which arrive at different valuations. It may be unrealistic to assume that the value of a tangible company asset on the balance sheet equals the value it would fetch if it were to be sold off.

The carrying value of an asset on a company's balance sheet may not reflect the true value of the asset. For example, a future charge to write down the value of an overvalued asset could dramatically reduce a firm's book value and change the P/B in one swipe. On the other side of the coin, the book value of a company doesn't always accurately measure its true worth, especially for firms with lots of intangible assets such as patents, human capital, and brand names that do not show up on the balance sheet. Some assets, like land, are also carried on a company's books at cost. If a company has held a property for a long time, chances are the value of the land is much greater than what its books state. Likewise, a company building may have depreciated to zero over time, yet may have a market value of millions of dollars. Similarly, a company operating in a very fast-moving industry may be showing a high-tech computer in its books at a significant value. That computer might, however, fetch very little in the market were it to be sold immediately. It is even more difficult to value intangible assets such as patents and brands. This problem is compounded by the fact that in recent times a far higher value has been placed on intangible assets than in the past.

The P/B multiple can be misleading when there are significant differences in the asset size of the firms under consideration because the firm's business model often dictates the asset size. A firm that outsource its production may have fewer assets, lower book value, and hence, a higher P/B multiple.

11.11 Determinants of M/B Ratio

A company's value is determined by three *value drivers* viz. Profitability, Advantage Horizon, and Reinvestment. The spread between the ROE and cost of equity is the firm's true profitability; the period for which a firm can maintain a positive (ROE − cost of equity) spread is called advantage horizon and the rate at which a firm reinvests (its earnings) is the reinvestment.

The greater the abnormal return, the longer the advantage horizon, the sooner the abnormal returns, the higher the market-to-book (M/B) ratio. (Fruhan 1979; Esty 1997).

The market value of equity can be obtained by discounting equity cash flows at an appropriate discount rate.

$$\mathrm{M} = \left[\mathrm{ECF}/\,(1+k)^1 + \mathrm{ECF}/\,(1+k)^2 + \ldots\ldots\ldots\ldots\right].$$

If we assume that cash flows and discount rate are constant the series reduces to perpetuity.

$$M = \frac{\mathrm{ECF}}{k}.$$

Further, if we assume that ECF = Net income, that is, retention is zero,

$$M = \text{Net income}/k.$$

But Net income = ROE × Book value of equity

$$M = [\mathrm{ROE} \times \mathrm{B}]/k.$$

Or

$$M/B = \mathrm{ROE}/k.$$

Thus, market-to-book ratio is a function of ROE and cost of equity.

If all earnings are returned to shareholders and earnings are constant

$$M = \frac{(\mathrm{ROE} \times B)}{(1+k)} + \frac{(\mathrm{ROE} \times B)}{(1+k)^2} + \cdots.$$

Divide both sides by B

$$\frac{M}{B} = \frac{(\mathrm{ROE})}{(1+k)} + \frac{(\mathrm{ROE})}{(1+k)^2} + \cdots.$$

Add and subtract k from each of the terms

$$\frac{M}{B} = \frac{[(\mathrm{ROE}+k)-k]}{(1+k)} + \frac{[(\mathrm{ROE}+k)-k]}{(1+k)^2} + \cdots.$$

The first term $(\mathrm{ROE}-k)$ is the abnormal earnings and the second term, k, is the normal earning.

It can be proved that the present value of this series is

$$\mathrm{PV} = 1 + (\mathrm{ROE}-k)[(1/k) - \{1/k(1+k)^n\}\ldots.. \tag{11.1}$$

This model assumes that retention is zero. Allowing for different rates would yield a more realistic model.

$$M = \frac{D_1}{(k-g)} = \frac{(\text{Net income} \times \text{payout})}{(k-g)}.$$

But

$$\text{Payout} = (1 - \text{retention}) = 1 - r,$$

g = sustainable growth rate = ROE × r

Net income = ROE × B

$$M = \frac{[\text{ROE} \times \text{B} \times (1 - r)]}{[k - (r \times \text{ROE})]}, \tag{11.2}$$

$$\frac{M}{B} = \frac{[\text{ROE} \times (1 - r)]}{[k - (r \times \text{ROE})]}. \tag{11.3}$$

If a firm pays out all its earnings as dividends, r is zero. Those firms that generate positive abnormal returns can increase value by retaining a larger fraction of earnings and invest in business.

Equations 1 and 2 can be combined as

$$M/B = [1 + (\text{ROE} \times r)]/(1 + k) + [\text{ROE}(1 - r)/(k - r \times \text{ROE})] \\ \times [1 - (1 + r \times \text{ROE})/(1 + k)^n].$$

Thus, M/B ratio is a function of ROE, retention rate and the advantage horizon, n.

11.12 The *P/S* Multiple

One of the most basic valuation ratios is the P/S ratio. The P/S ratio is equal to a stock's market price divided by its sales per share.

$$\frac{P}{S} = \frac{\text{Market Price per Share}}{\text{Sales per Share}}.$$

The good thing about the P/S ratio is that sales are not subject to much accounting assumption and manipulation like earnings. Although firms could use accounting tricks to lift sales, it is much harder to do and far easier to catch. Further, sales are not as volatile as earnings, because one-time charges or gains can depress or boost earnings temporarily. Plus, the bottom line of economically cyclical companies can vary significantly from year to year, but sales are a more stable benchmark. Moreover, the P/S ratio can be used for companies that do not have positive earnings.

The relative smoothness of sales makes the P/S ratio useful for quickly valuing companies with highly variable earnings by comparing their current P/S ratios with historic P/S ratios.

Valuing established companies is difficult enough, but valuing start-up companies is trickier. Typically, most start-ups make losses for several years, yet many technology start-ups, for example, can have huge valuations. In the absence of profits, many analysts instead focus on sales growth as a measure of the future growth potential of such companies, and this is reflected in the sales-to-stock price ratio.

11.13 Limitations of *P/S* Ratio

Despite several advantages, the P/S ratio has some limitations. One major flaw is that sales may be worth a little or a lot, depending on a company's profitability. If a company is posting billions in sales, but it is losing money on every transaction, we would have a hard time pinning an appropriate P/S ratio on the shares because we have no idea what level of profits (if any) the company will generate. Further, sales may not have much correlation with cash flow, the fundamental driver of value.

When using the P/S ratio, it is important to keep in mind that a dollar of earnings has the same value regardless of the level of sales needed to create that dollar. A dollar of sales at a highly profitable firm is therefore worth more than a dollar of sales for a company with a narrower profit margin. That is, P/S ratios do not capture differences in cost structures. Thus, the P/S ratio is generally useful only when comparing firms within an industry or industries with similar profitability levels, or when looking at a single firm over time.

A firm's revenue recognition policy has a bearing on the P/S multiple. Managers may accelerate revenues by billing now and delivering later. This will boost the multiple.

11.14 The Price/Cash Flow Ratio

The price-to-cash flow multiple is the ratio of market price of stock and operating cash flow per share.

The multiple can be computed using different definitions of cash flow. Cash flow can be calculated using either gross cash flow (i.e., net income + noncash charges) or free cash flow to equity (i.e., EBIT $(1-T)+$ noncash charges − capital expenditure − incremental working capital − after tax interest payments − principal repayments + new borrowings) or EBITDA (i.e., earnings before interest, tax, depreciation, and amortization).

The advantage of the price-to-cash flow ratio is that:

- It is harder to manipulate than earnings
- It is more stable than earnings
- It obviates the need to handle differences in quality of earnings between firms

The drawback of this ratio is that the denominator can be expressed in more than one way. Using one definition over the other has both advantages and disadvantages.

11.15 The EV/EBITDA Ratio

It is the ratio of enterprise value and EBITDA. Since EBITDA flows to both shareholders and bondholders the numerator has enterprise value.

$$\text{Enterprise Value} = \text{Market Value of Equity} + \text{Book Value of debt.}$$

This ratio is more useful in situations where:

The firms under comparison have different financial leverage (EBITDA is pre-debt flow).

The firm under analysis has high levels of depreciation and amortization (e.g., airline companies).

All the key valuation measures for the General Electric Company are given in Exhibit 11.3.[4]

11.16 Yield-Based Measures

In addition to ratio-based measures, one can also use yield-based measures to value stocks. For example, if we invert the P/E and divide a firm's EPS by its market price, we get an earnings yield. If a stock sells for \$40 per share and has \$2 per share in earnings, then it has a P/E of 20 (40/2) but an *earnings yield* of 5% (2/40). Unlike P/Es, the nice thing about yields is that we can compare them with alternative investments, such as bonds, to see what kind of a return we can expect from each investment. One main difference, however, is that earnings generally grow over time whereas bond payments are fixed.

In early 2005, 10-year treasury bonds were yielding a risk-free return of about 4.5% in the United States. Therefore, one would want to demand a higher rate of return from stocks because they are riskier than treasuries. A stock with a P/E of

Exhibit 11.3 Valuation measures for General Electric

Market Cap (intraday):	353.33B
Enterprise Value (19-Mar-07):	772.01B
Trailing P/E (ttm, intraday):	17.15
Forward P/E (financial year ending 31-Dec-08):	13.80
PEG Ratio (5 yr expected):	1.55
Price/Sales	2.21
Price/Book	3.16
Enterprise Value/Revenue:	4.81
Enterprise Value/EBITDA	22.899

[4] http://finance.yahoo.com/q/ks?s = GE accessed on March 19, 2007.

20 would have an earnings yield of 5%, which is a bit better than treasuries, but perhaps not enough considering the additional risk one is taking. It all depends on whether the company will be able to grow its profits in the future to make accepting a 5% yield today worthwhile.

A stock with a P/E of 12 would have an earnings yield of 8.3% (1/12), which is much better than treasuries, even if earnings never grow. Thus, in this situation one might be induced to take on the additional risk of owning the stock.

Dividend yield is actually one of the oldest valuation methods. It was very popular back in the days when dividends were the primary reason people owned stocks, and it is still widely used today, mainly among income-oriented investors. Dividend yield is equal to a company's annual dividend per share divided by a stock's market price. For example, a company that pays an annual dividend of $1.00 per share and trades for $20 has a dividend yield of 5% (1/20). If that same stock's price rose to $40 a share, its dividend yield would fall to 2.5% – the more expensive the stock, the lower the yield.

$$\text{Dividend Yield} = \text{Annual Dividends per Share/Market Price per Share}$$

This strategy entails investing in the top 100 highest dividend yielding stock in the S&P 500 (or Dow Jones Index). The top dividend yields portfolios invested in the S&P 500 (top 100) returned 3% per year more than the S&P 500 index whereas the lowest yielding stocks lagged the market by almost 2% per year. Choosing the ten highest yielding stocks among the largest 100 S&P 500 stocks does even better than the Dow 10. A thousand dollars invested in these high yielding stocks at the end of 1957 accumulates to more than $811,000 in 2005.[5]

The Dow Jones Industrial Average (DJIA) has outperformed the S&P 500 for the period 1958–2003. The Dow-10 strategy consists of buying the ten highest yielding Dow stocks and rebalancing annually. The return of the Dow-10 strategy is much better than the Dow industrials.

The "Dogs of the Dow" (strategies of investing in the unpopular stocks in the DJIA i.e., buying either the six or ten issues in the DJIA selling at the lowest earnings multiples and rebalancing at holding periods ranging from 1 to 5 years or they also involve picking stocks with high dividend yields) is a stock picking strategy that has been the subject of a great deal of attention in the last few years. Proponents of the strategy cite the fact that it has outperformed the DJIA and other indexes by significant margins. Many cite figures for the last 25 years with others going back even farther. Given below are some facts about the high dividend Dow stocks:

During the tech bubble of the late 1990s, the high dividend stocks of the Dogs of the Dow were up 28.6% in 1996, up 22.2% in 1997, up 10.7% in 1998, and up 4.0% in 1999.

During the difficult bear market years of 2000–2002, the Dogs of the Dow were up 6.4% in 2000, down 4.9% in 2001, and down 8.9% in 2002, *and that was enough to significantly outperform the Dow, S&P 500, and NASDAQ.*

[5] www.jeremysiegel.com

In 2003, the high dividend stocks of the Dogs of the Dow gained 28.7% and made new, all-time highs despite the massive bear market of 2000–2002!
In 2004, the high dividend yield Dogs of the Dow remained in record territory with a 4.4% gain and then gave back 5.1% in 2005.
In 2006, the Dogs of the Dow surged to new record highs with a gain of 30.3%. The Small Dogs of the Dow did even better with a gain of 42%!

Following the Dogs-of-the-Dow strategy is ridiculously simple. After the stock market closes on the last day of the year, of the 30 stocks that make up the DJIA, select the ten stocks which have the highest dividend yield. Then simply get in touch with your broker and invest an equal dollar amount in each of these ten high yield stocks. Then hold these ten "Dogs of the Dow" for 1 year. Repeat these steps each and every year. That's it!

A variant of the Dow-10 strategy is the Foolish-Four strategy – consisting of investing 40% of a portfolio in the second lowest priced of the 10% and 20% each in the third, fourth, and fifth lowest priced. The rational for "The Foolish Four" strategy is back-tested results showing the strategy to have yielded 25.5% annually over a 20-year period (Gardner et al. 1996).

Another variant of the Dogs–of-the-Dow strategy is the Small-Dogs strategy (sometimes referred to as the Puppies of the Dow or the Flying Five). This strategy involves selecting the five Dogs with the lowest stock price and investing an equal dollar amount in each of these five high yielding, low priced stocks. Then hold these five "Small Dogs of the Dow" for 1 year. Investing in the Puppies of the Dow would have resulted in a 20.9% average annual return since 1973! Exhibit 11.4 lists the ten highest yielding Dow stocks as of the most recent *Friday* close. Note that the table contains small dogs as well:

It is important to understand that the Foolish-Four and Dow-10 strategies ignore volatility and benefits of diversification. In other words, these strategies are more volatile and riskier than investing in an index like DJIA. The issue of whether the Dow 10 indeed does better than the Dow 30 after accounting for risk, taxes, transaction costs, etc. was addressed by one academic study (McQueen et al. 1997).

Exhibit 11.4 The Dow stocks ranked by yield on 3/23/07

Company	$ Price on 3/23/07	Yield on 3/23/07 (%)	Small Dog
Pfizer	25.66	4.52	Yes
Verizon	38.12	4.25	Yes
Citigroup	51.72	4.18	No
Altria	85.47	4.02	No
AT&T	38.88	3.65	Yes
Merck	44.45	3.42	No
General Electric	35.82	3.13	Yes
General Motors	31.99	3.13	Yes
DuPont	51.03	2.90	No
J P Morgan Chase	48.52	2.80	No

This study finds that the Dow 10 did in fact produce significant excess returns over the 50-year period. The average annual return (arithmetic mean) for the Dow 10 was 16.77% versus 13.71% for the Dow 30. Higher risk as measured by standard deviation (19.10% versus 16.64%) accompanied the higher returns. The authors point out that transactions costs and risk explain most of the Dow 10 excess return, and they believe that most if not all of the remaining excess return would have gone to the IRS. The authors also looked at sub periods and found that during some extended periods the strategy outperformed, but during other long stretches (decades) the authors suggest that economically, an investor would have been better off (after adjusting for risk, transactions costs, and taxes) in the Dow 30.

As with all valuation ratios, dividend yield must be used with caution. Stocks with very high dividend yields might seem like bargains, but these companies are often going through financial problems that have caused their stock price to plunge. It is not unusual for companies in such situations to cut their dividend in order to save cash, so their actual dividend yield going forward might be lower than the currently reported figure. Lastly, one major drawback of dividend yield is that it is useless for companies that do not pay a dividend – a group that includes many technology stocks.

Formal statistical tests of the ability of dividend yields to forecast future returns have been conducted by Fama and French (1988) and Campbell and Shiller (1988a). These studies find that as much as 40% of the variance of future returns for the stock market as a whole can be predicted on the basis of the initial dividend yield on the index.

This phenomenon does not work consistently with individual stocks. That is, investors who purchase a portfolio of individual stocks with high dividend yields in the market will not earn a particularly high return.

11.17 What do Analysts do?

Given the fact that analysts have the choice of choosing from a wide menu of ratios and measures what do they actually do? Academic surveys suggest that a large fraction of analysts concentrate on earnings and book value multiples. The same studies suggest that EVA and DCF are less popular. The result of one study is presented in Exhibit 11.5.

11.18 Concluding Comments

Although analysts around the world continue to use multiples for the purpose of valuation, it must be noted that multiples have restricted use in the sense that one cannot naively compare them across firms, industry groups, and time. Indeed finding a relevant peer group itself can be a daunting task. A better way to apply them

Exhibit 11.5 Equity valuation analysis: what do analysts use?

Earnings multiple	99%
P-E	97%
Relative P-E	35%
Revenue multiple	15%
Price-to-book	25%
Cash flow multiple	13%
DCF	13%
EVA	2%
Other	4%

is to estimate a regression equation as demonstrated in this chapter. Further, the multiples approach is sometimes used to estimate a subject company's equity value rather than its enterprise value. In such cases, the multiples computed from comparable companies are derived from stock prices or market capitalization rather than enterprise values (which include the value of debt). Multiples are also commonly used to estimate terminal values as pointed out in the last chapter.

Analysts also use industry specific multiples like price per square feet or new store openings or proven reserves of oil/gas, number of pipeline customers, etc.

In general, the following may be kept in mind while using multiples:

- Asset multiple (M/B ratio) generates more precise and less biased estimates than do the sales and earnings multiple.
- The EBITDA multiple generally yields better estimates than does the EBIT multiple.
- The accuracy and bias of value estimates vary greatly by company size, company profitability, and the value of intangibles.

Price may be estimated as a multiple of any of the following:

- Sales
- EBITDA
- EBIT
- Net income
- Book value (retained earnings)

This is essentially a simplified income statement. As you move down from sales to book value, accounting choices and distortions become more relevant due to income and cost recognition, depreciation rules, interest expense, etc. While sales are the least affected, book value is the most affected (due to accounting distortions). But as you move down, you incorporate the effects of greater capital and operating efficiency. So the trade off is between incorporating accounting distortions and recognizing operating efficiency. That is, as you move down you are closer to cash flow, the driver of value. In choosing a multiple, find the one that has the lowest variance across all stocks.

The P/E multiple captures risk (via the cost of equity), industry effect, and growth because $P/E = 1/k - g$, according to the Gordon Model.

Size, an important determinant of the P/E multiple, seems to be left out of the equation. The cost of equity can be estimated either using the CAPM or the Fama–French three-factor model, which captures the size and book/market effect in addition to the systematic risk. In other words, using the Fama–French model to estimate the cost of equity enables us to capture size as well.

11.19 End of the Chapter Exercises

1. Which of the following would you consider the best indicator of an undervalued firm?

   (a) A firm with a lower P/E ratio than its peer group, and a lower expected growth rate.
   (b) A firm with a lower P/E ratio than its peer group and a higher expected growth rate, and higher risk.
   (c) A firm with a lower P/E ratio than its peer group, and lower expected growth rate, and lower risk.
   (d) A firm with a lower P/E ratio than its peer group, a higher expected growth rate, and lower risk.

2. Refer to the data given below for a valuation target and three comparable companies:

Variables	Valuation target	Company **I**	Company **II**	Company **III**
Long term forecast EPS growth rate	8.0%	8.2%	7.0%	4.0%
5-year growth in sales	15.0%	14.9%	12.0%	8.0%
Revenues	496	430	11,420	582
Net income	52	42	1,037	56
EBIT	126	111	1,921	128
Book value equity	263	270	5,704	410
Book value debt	440	467	3,261	422
Nondebt liabilities	46	44	980	64
Market capitalization		764	17,007	896
Market value firm		1,231	20,268	1,318
EBIT margin	25%	26%	17%	22%
Net margin	10%	10%	9%	10%
Asset turnover	66%	55%	115%	65%
Leverage	285%	289%	174%	219%
Return on equity	19.8%	15.6%	18.2%	13.7%

Estimate the P/E, market value of firm/EBIT, equity P/B, and Firm P/B multiples for the comparable companies and the target. Assume equal weight for these multiples.

1. What are the limitations of P/E, M/B and P/S multiples?
2. How is intrinsic P/E multiple derived?
3. Explain the rationale for using PEG ratio as an investment metric.
4. Explain how yield based measures are used in investing.
5. What is the "dogs of the dow" strategy?

References

Asquith P, Mikhail MB, Au AS (2005) Information content of equity analyst reports. J Financ Econ 75(2):245–282

Block S (1999) A study of financial analysts: practice and theory. Financ Anal J 55(4):86–95

Campbell J, Shiller R (1988a) Stock prices, earnings and expected dividends. J Finance 43(3):661–676

Campbell J, Shiller R (1988b) Valuation ratios and the long-run stock market outlook. J Portfolio Manage 24(2):11–26

Demirakos E, Strong NC, Walker M (2004) What valuation models do analysts use? Accounting Horizons 18(4):221–240

Esty BC (1997) Note on Value Drivers. HBS Case Study No. 9-297-082

Fama E, French K (1988) Permanent and temporary components of stock prices. J Politic Econ 96(2):246–273

Fluck Z, Malkiel B, Quandt R (1997) The predictability of stock returns: a cross sectional simulation. Rev Econ Stat 79(2):176–183

Fruhan W (1979) Financial strategy: studies in the creation, transfer and destruction of shareholder value. Irwin, Homewood, IL

Gardner D, Gardner T (1996) The motley fool investment guide: how the fools beat wall street's wise men and how you can too. Simon & Schuster

Lie E, Lie H (2002) Multiples used to estimate corporate value. Financ Anal J 58(2):44–54

McQueen G, Shields K, Thorley S (1997) Does the 'Dow-10 Investment Strategy' beat the dow statistically and economically? Financ Anal J

Neill J, Pfeiffer G (1999) The effect of potentially dilutive securities on P/Es. Financ Anal J 55(4):58–64

Chapter 12
Real Options Perspective of Security Analysis*

S.R. Vishwanath

12.1 Chapter Introduction and Objectives

The recent misvaluations of high-tech growth stocks (i.e., the Internet stocks' boom and bust) have highlighted the difficulty of valuing dynamic companies whose cash flows and future growth are uncertain. Companies with no foreseeable profits might enjoy significant valuations based on investors' perceptions (or misperceptions) of their growth potential. This chapter presents a relatively "new" valuation methodology based on option pricing theory that practitioners can apply in valuing companies.

This chapter has the following objectives:

- Bring out an analogy between financial options and real options
- Highlight the different types of real options
- Introduce valuation of real options
- Highlight the application of real options valuation in security analysis

The recent misvaluations of high-tech growth stocks (i.e., the Internet stocks' boom and bust) have highlighted the difficulty of valuing dynamic companies whose cash flows and future growth are uncertain. Companies with no foreseeable profits might enjoy significant valuations based on investors' perceptions (or misperceptions) of their growth potential. Amazon.com, for instance, was valued at over $ 40b in 2000, though the company was not expected to make profits for few more years. Although this was a classic case of oversimplification of demand estimation (analysts were

S.R. Vishwanath
Institute of Management Technology, 603, Khullar Apartments, Byramji Town,
Nagpur 440001, India
e-mail: srvishy@gmail.com

* This chapter assumes elementary understanding of option pricing theory. Readers unfamiliar with option pricing may first read Chap. 14 (Pricing Equity Options) before reading this chapter. We have included real options under valuation models for the sake of preservation of continuity and coherence.

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_12,

Exhibit 12.1 Value of growth option reflected by stock prices

Company	M.V of equity $m	Estimated value of growth options $m[a]	% of market value represented by growth options
Motorola	5,250	3,850–4,410	73–84
Apple Computer	2,000	1,340–1,604	67–80
Digital Equipment	5,690	3,790–4,550	67–80
IBM	72,890	36,457–51,030	50–70
Union Carbide	4,350	2,483–3,230	57–74
Goodyear	2,520	520–1,320	21–52
General Foods	2,280	167–1,012	7–44

[a]Range of growth option values are estimated by subtracting the high and low value of capitalized earnings (at discount rates ranging from 15–25%) from the market value of equity.

pointing out that even if Amazon captures 1% of the worldwide market for online book sales, it would be one of the largest companies), there is evidence to prove that stock markets value valuable growth options held by companies.

The estimated value of growth option for some well-known American companies is presented in Exhibit 12.1 (Kester 1984).

As can be seen from the exhibit, up to 80% of Motorola's market value in 1984 came from future growth opportunities.[1]

While discounted cash flow (DCF) is appropriate for valuing existing operations with rather predictable cash flows, Real Options Valuation is emerging as the most effective way to quantify the additional value of growth opportunities that may, to many investors, appear somewhat nebulous. Real Options Security Analysis can be useful in identifying companies whose growth potential is not properly priced in by the market and which are mispriced relative to comparable stocks (with comparable quality of management) in the same industry or sector. Mutual funds or hedge funds could find such a tool particularly valuable in their security selection and portfolio management activities.

12.2 What are Real Options?

Real Options framework is a systematic integrated decision analysis approach. It incorporates financial theory, economic analysis, applied decision sciences, option pricing theory, and statistical modeling in valuing real assets as opposed to financial assets. It is useful in a dynamic and uncertain business environment where business decisions are flexible and dynamic. It is applicable within the context of strategic decision-making, valuing, and justifying investment opportunities and

[1] Range of growth option values are estimated by subtracting the high and low value of capitalized earnings (at discount rates ranging from 15% to 25%) from the market value of equity.

capital expenditures in e-business, research, and development, biotechnology, and high-tech industries.

Real options analysis extends financial option theory to options on real, or non-financial, assets. A financial option gives its owner the right but not the obligation to purchase or sell a security at a given price. Similarly, a company that has a real option has the right but not the obligation to make a potentially value-accretive investment. Investment examples include new plants, line extensions, joint ventures, and licensing agreements.

This approach is best viewed as a complement to standard DCF valuation. For those comfortable with the DCF model, real options have substantial intuitive appeal. Real options allow for a better modeling of the decision by adding another dimension to the problem viz. managerial flexibility.

Consider the example of an oil company bidding for a right to explore oil. The project is similar to buying a call option on oil. In both the cases one acquires the right to purchase oil at a specific price at some point in time in future.

That is real option pricing models rely heavily on financial market data. So the framework, unlike DCF, is closely aligned with the real world.

The traditional NPV approach had several disadvantages: it provides single decision pathway; it allows only one future outcome; it locks in a single risk free rate and requires all assumptions to be determined at the outset.

The real options approach, however, allows multiple decision pathways, recognizes managerial decision making, allows variable risk, and incorporates new assumptions over time.

The Net Present Value rule falls short of option pricing theory in the following ways:

- *Flexibility*: Flexibility is the ability to defer, abandon, expand, or contract an investment. Because the NPV rule does not factor in the value of uncertainty, it is inherently less robust than an options approach in valuing flexibility. For example, a company may choose to defer an investment for some period of time until it has more information on the market. The NPV rule would value that investment at zero, while the real options approach would correctly allocate some value to that investment's potential.
- *Volatility*: In standard finance, higher volatility means higher discount rates and lower net present values. In options theory, higher volatility – because of asymmetric payoff schemes – leads to higher option value. That is, volatility is something good.
- *Contingency*: This is a situation when future investments are contingent on the success of today's investment. Managers may make investments today – even those deemed to be NPV negative – to access future investment opportunities. Traditional budgeting models inadequately value these option creating investments. Pharmaceutical company investments are a good example.

Future spending on drug development is often contingent on the product clearing certain efficacy hurdles. This is valuable because investments can be made in stages, rather than all up-front.

In a sense, real options theory allows us to value the unimaginable. This means that industries with high uncertainty – like the Internet – actually have the most valuable options.

Real options bridge the gap between finance and strategic planning by providing a means to incorporate both the impact of uncertainty inherent in investment opportunities and how managerial actions can limit losses or capitalize on upside potential. This valuation process not only guides managers to focus on the different opportunities and strategic alternatives, but also provides a systematic methodology to measure the influence of contingent actions on the very nature of risk itself and its impact on project value.

Traditional Capital Budgeting assumes management is passively committed to project implementation thereby treating value as derived from expected cash flows alone. On the basis of option pricing theory, real options expand value by improving upside potential while limiting downside losses. The real options framework allows managers to enhance shareholder value in dynamic businesses through the creation and optimal management of strategic and operating options. Typically, the underlying asset is the gross project value of discounted expected operating cash inflows. Sometimes, multiple stochastic variables are needed to define a sufficient state space for decision-making. This value manifests as a collection of real options embedded in capital-investment opportunities. Managerial flexibility that can adapt future decisions to unexpected market developments represents a critical source of value creation in a changing environment. Many types of real options occur naturally while others may be planned or built in at some extra cost from the outset. Multiple interacting options can occur in parallel, in sequential contingent stages, or a combination of these to yield a combined value different from the sum of separate parts. Competitive interactions can impact strategic investment decisions. Optimal investment timing policies in a preemptive competitive environment may differ under anticipated unilateral or multilateral damage. The impact of random competitive arrivals and simple game-theoretic competitive reactions can be analyzed in an options-valuation framework. When analytic solutions are not available, standard numerical methods based on simulation, finite-difference, or lattice methods are used to solve complex option problems with multiple interacting options and multiple underlying uncertainties. An option-based strategic planning and control framework integrates various sources of value such as synergy among groups of parallel projects and interdependencies among projects over time to provide a rationale for control of targets.

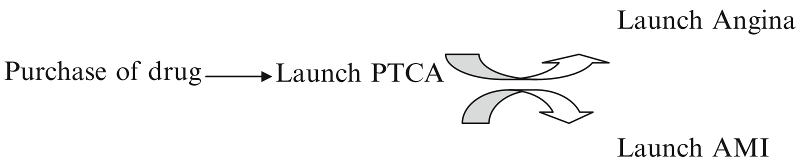
Many companies like General Motors, General Electric, Boeing, AT&T, BP, and Microsoft have embraced the real options approach to valuation.

An example is in order.[2] Pharmaceutical companies like Eli Lilly that need to value purchase rights of a new drug (for anti-thrombotic treatment, e.g., in Angioplasty/PTCA) have to decide the optimal marketing expansion strategy. They have to decide whether the follow-on-related extensions (Angina and Acute Myocardial

[2] This example is based on a presentation by Real options group.

Infraction) have to be launched sequentially or simultaneously. A sequential strategy involves launching Angina first and then AMI in a span of two years. A parallel strategy involves launching AMI directly independently of Angina.

The decision is shown below:



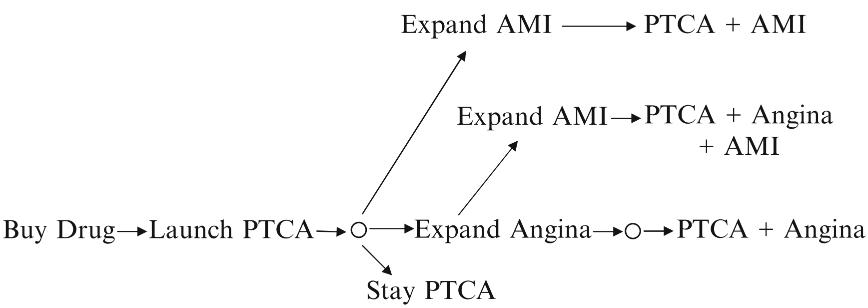
The projections of target patients for PTCA are highly uncertain. Subsequent extensions depend on PTCA performance. Within two years the company can decide to exercise this expansion option, pay then the development cost, and proceed to the drug's extension to other applications, Angina and AMI. If the performance of PTCA does not warrant an extension the company can abandon the idea avoiding subsequent costs.

The main risk driver is the demand uncertainty for the PTCA market. The upside potential is enhanced by two American-type expansion options.

The DCF methodology would assume that these investments are now-or-never propositions. The real options approach correctly allows for multiple decision pathways as shown in Exhibit 12.2.

The company can expand into Angina if the present value of the expanded market is higher than the extra development cost to enter the Angina niche. The company can expand into AMI either directly if PV of expansion into AMI is higher than the required development plan outlay or indirectly to exploit synergies from first developing the Angina market. Expanding to AMI through Angina would result in a higher expansion factor than going directly to AMI due to the developed credibility of the drug's effectiveness among surgeons. This credibility and promotion also reduces the extra development cost needed for AMI. The value of Angina partly depends on the AMI option.

Exhibit 12.2 Decision map



12.3 Types of Real Options

Capital projects are like call options in the sense that both involve the right but not the obligation to acquire an asset at a specified price on or before a certain date. The analogy between project characteristics and call option is given in Exhibit 12.2.

The amount spent on the project is the exercise price. The present value of cash flows from the project is the stock price. The length of time the company can defer the investment decision without losing the investment opportunity corresponds to time to maturity. The uncertainty in the project's cash flows corresponds to the standard deviation of returns. The cash flows lost due to competitors who have fully committed corresponds to dividends.

An analogy between capital projects and a call option is presented in Exhibit 12.3.

The impact of changes in option variables on the value of the option is shown in Exhibit 12.4.

Timing Option: Timing option enables managers to defer investment for a certain period of time without losing the opportunity. In other words, managers would always want to spend later rather than sooner. If an investment can be deferred for

Exhibit 12.3 The analogy between capital projects and a call option

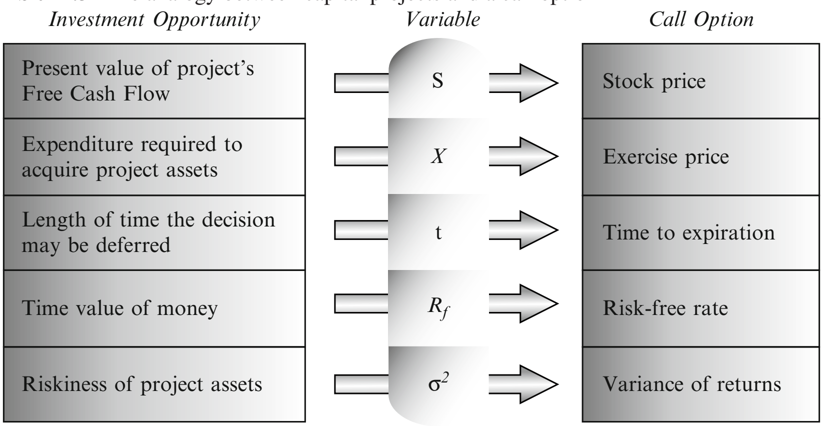


Exhibit 12.4 The impact of changes in option variables on the value of option

Variable	Value of real option
Increase in the PV of the Project	Increase
A higher investment cost	Decrease
A longer time to maturity	Increase
Increase in uncertainty (Volatility of cash flows)	Increase
Increase in risk free rate	Increase
Increases in cash flow lost	Decrease

1 year, one could put the investment in a bank for 1 year and withdraw it when the time is ripe to invest. That is, the investment X would be invested at r_f for 1 year. So, the amount now is the present value of X discounted at r_f.

$$\mathrm{PV}(X) = X/(1+r_f)^t.$$

Since our objective is to refine NPV to incorporate other option variables like r_f, t, and σ let us redefine NPV as $\mathrm{S} - \mathrm{PV}(X)$. As with financial options this can be expressed as a ratio.

$$= \mathrm{S}/\mathrm{PV}(X)$$

and cumulative volatility $= \sigma\sqrt{t}$.

We can use these two values to estimate the value of the option as percentage of value of underlying assets from standard option pricing tables.[3]

An example is in order. A company is investing \$300 million in a project. The project is expected to generate cash flows of \$75 million p.a. for five years. A company has the option of investing in the project (i.e., develop the product) in the next 5 years. That is, the company can delay the project for a period of five years without seriously jeopardizing the value of the project. A simulation of project cash flows suggests that the standard deviation of cash flows is 40%. The risk-free rate is 6% and the cost of capital for the company is 12%.

$X = \text{Investment} = \$300\,\text{million}$
$S = \text{PV of cash flows @ } 12\%$
$t = 5$ years
$\sigma = 40\% = 0.4$
$\mathrm{PV}(X) = 300/(1.06)^5 = 300/1.338 = \$224.2\,\text{million}$
$S = 75\times$ Present Value Interest Factor of an Annuity (12%, 5 years) $= \$75 \times 3.605\,\text{million} = \$270.375$ million

Traditional NPV $= \$270.375\,\text{million} - \$300\,\text{million} = -\$29.625$ million. This analysis does not take into consideration the possibility of deferring the investment and the volatility of the returns.

$$\mathrm{S}/\mathrm{PV}(X) = 270.375/224.2 = 1.2,$$
$$\sigma\sqrt{t} = 0.4 \times \sqrt{5} = 0.89.$$

The value of the call option as percentage of value of underlying asset from the option pricing table is 40.8%, that is, $0.408 \times 270.375 = \$110\,\text{million}$.

[3] Most standard corporate finance texts like Principles of Corporate Finance by Brealy and Myers provide option pricing tables like the time value tables.

12.4 Growth Option

A growth option is characterized by an early investment (in R&D say) which leads to a chain of inter-related projects opening up future new generation products and processes, access to new market, oil reserves, etc. Any investment that creates new investment opportunities can be characterized as a growth option. Companies derive their value from two sources: assets in place and present value of growth opportunities. Stock markets realize it when pricing securities.

Just as package of bond and warrants are valued separately, the option component embedded in projects should be evaluated separately and then added to the value obtained from the DCF methodology. Assume that a project is expected to lead to a second-generation investment. The NPV of the entire proposal may be written as follows:

NPV = NPV (Phase1) + Call Value of Phase 2.

To evaluate growth options embedded in projects

- Segregate discretionary expenditure and its associated cash flows of Phase 2 project from Phase 1 project.
- Find the NPV of phase using the traditional DCF approach.
- Discount the discretionary spending to the present using an appropriate *risk-free rate*. If the discretionary spending that leads to Phase 2 project is Rs.300 m to be made in the third year, discount it to the present by using a three-year risk-free rate. This constitutes X.
- Find the present value of cash flows (net of inflows and *routine* expenditure on working capital and fixed assets) using WACC. This is S.
- Find $\mathrm{S}/\mathrm{PV}(X)$.
- Estimate cumulative volatility $(\sigma\sqrt{t})$; t is 3 years in this case. Volatility can be estimated in several ways. One approach is to estimate the historical volatility of the company's stock and take it as proxy for the volatility of returns from the project undertaken by the company. Another approach is to use implied volatility of options on the company's stock traded in exchanges. The third approach is to simulate project cash flows and find the standard deviation of NPV using a standard package like Crystal Ball.[4]
- Find the value of the call option and add it to the NPV of Phase 1.

Cox Communications, a cable company based in the United States uses real options analysis to value additional capacity. Of the 750 MHz available in an upgraded cable system, approximately 648 MHz is being used for four streams: analog video, digital video, high-speed data, and telephone. The remaining 102 MHz is a future tier of interactive services like video telephone, interactive e-commerce, interactive games, and other application that require high bandwidth that do not exist today. The value of the growth option is not reflected in the DCF methodology.

[4] Crystal Ball is a product of Decisioneering. See www.decisioneering.com.

Let us go back to the Eli Lilly situation presented earlier. The primary input data for the base-case DCF analysis (launch PTCA) are as follows:

Unit price	= Lira 1,610 m
Project life	= 7 years
Cost of goods sold	= 65% of revenues
General and administration expenses	= 6% of revenues
Tax rate	= 50% of EBIT
WACC	= 8.75%

The present value of development cost is Lira 480 million (L500million spread equally over 2 years).

The forecast of free cash flows for the company is shown in Exhibit 12.5.

The NPV of the drug is a negative 111 million. This analysis suggests that Eli Lilly should not proceed with the drug launch.

A similar DCF analysis suggests that Angina has a NPV of −1,118 million and AMI has a NPV of −730 million.

As pointed out earlier, this analysis ignores the volatility of changes in PTCA value. Treating Angina and AMI as options would yield an option value of 195.92 million. Subtracting the negative NPV of PTCA provides the "true" NPV of the venture (85.92 million).

Exhibit 12.5 DCF (NPV) for PTCA (L million)

Years	1	2	3	4	5	6
Total Patients	7,000	7,600	8,200	8,700	9,300	10,000
Market Share	0.1	0.15	0.2	0.2	0.2	0.2
Revenues	1,127	1,835	2,640	2,801	2,995	3,220
less: COGS	733	1,193	1,716	1,821	1,946	2,093
Less: marketing costs	1,000	650	500	250	250	200
less: general and admin expenses	68	110	158	168	180	193
equals: EBIT	673	118	266	562	618	734
Less: taxes	337	59	133	281	309	367
equals: net free cash inflows	337	59	133	281	309	367
(A) PV of cash inflows	370					
Development cost	500	500				
After tax development cost	250	250				
(B) PV of development cost	481					
NPV = A−B	−111					

Source: Real Options Group

12.5 Abandonment Option

If market conditions deteriorate severely, management can abandon operations and realize resale value of project assets in second-hand markets. Abandonment options are important in capital-intensive industries, financial services, and new product introduction in uncertain markets.

In a competitive industry with over capacity management has to continuously consider whether to stay or get out. The actual decision depends on the value of the project below which management may choose to abandon and the value above which extension could take place. An abandonment option is a put option.

$$\text{Value of Put} = -S\,\mathrm{e}^{(b-r)T}N(-d_1) + X\,\mathrm{e}^{-rT}N(-d_2).$$

The development of an oil field consists of sequential investments in test drilling, evaluation drilling, and production capacity. The investment in test drilling is a first step in a series of investments. The company has the option to abandon the project at various stages depending on the payoffs. Likewise, pharmaceutical companies hold valuable abandonment options.

Glaxo is a pharmaceutical firm that aims to be the worldwide leader in the research, development, and marketing of drugs for human consumption. Since 1980, Glaxo concentrated its activities on prescription drugs, focusing its skills and resources on the development of safer and more effective drugs. An area of focus where Glaxo can have competitive advantage is antibiotics.

Shortly after starting antibiotics in therapy, bacteria mutate faster producing enzymes that inactivate the drug reducing its therapeutic value ("b-lactamase" process). Glaxo's research laboratories isolated a new synthetic compound (Tribactam) to prevent this effect. The development enhances Glaxo's strategy to be a leader in antibiotics. A drug development project goes through the following milestones:

Activity	Year
Primary research	0
Patent filing	2
Pre-clinical tests	3
First stage trials	4
Patent group	6
Second stage trials	8
Third stage trials	11
Regulatory approval	12
Launch oral	13

Glaxo can either launch both oral (solid) injectable versions at the same time or launch the injectable version a year later. The second strategy has less risk since oral version has wider market use and the entry into the hospital market would be more informed. The main driver in this case is the demand uncertainty of oral version. Glaxo, in essence, owns an abandonment option at the third stage and a growth option into hospital market within a year following the successful launch of oral version.

The project can be abandoned during development if PV from continuing is less than planned (third stage) investment or if salvage value (e.g., from selling rights to biotech firm) is higher.

The option to abandon planned third stage development (or sell for salvage value) depends on follow-on option to expand (injectable). There are states where project has negative NPV but is worth investing to capture value of option to expand later. Exercising abandonment kills option to expand later. The forecast of free cash flows is shown in Exhibit 12.6.

The volatility of demand was estimated to be 35%. Given a risk-free rate of 3% and a salvage value of 5million the real option value works out to £29.3 million (the option to expand has a value of 14.6 million and the option to abandon has a value of 14.7 million). So, the true value of the project is -2.7 million $+29.3$ million $= 26.6$ million, not -2.7 million as the DCF methodology suggests.

12.6 Real Options Security Analysis in Practice

Several companies have started advising investors and fund managers on the implementation of real options approach to security analysis. The Real Options Group has developed a market valuation and security analysis tool known as Real Options Security Analysis.[5] ROSA™ is a market data-based statistical methodology which can be used to advise on stock selection or portfolio management. ROSA uses proprietary statistical analysis to identify companies or products whose growth potential is not properly priced in by the market or is out of balance with the company's product portfolio mix or with its main competitors in its industry given their level of volatility and other key option-based characteristics. ROSA uses recent market data on option-related variables such as firm-specific and market volatility, an index of managerial flexibility or asymmetry of returns, and the company's degree of R&D and Capex to determine a firm's (or product's) growth option potential and its percentage of mispricing. ROSA is best used as an efficient screening devise or as a complementary tool used jointly with S-ROV fundamental option analysis and the ROG software based on an in-depth understanding of management's strategic plans and growth options.

[5] http://www.rogroup.com.

Exhibit 12.6 Base case NPV of the new drug (£m)

Years	1	2	3	4	5	6	7	8	9	10	11	12
Revenues						95	184	209	219	260	260	
Less: COGS						22	58	74	81	86	90	
Less: marketing and distribution expenses						95	138	105	55	65	65	
Less: depreciation						1.7	1.7	1.7	1.7	1.7	1.7	
Equals: EBIT						−23.7	−13.6	28.8	81.2	107	103.3	
Less: taxes						−8.5	−5.8	7.7	24.1	32.3	30.3	
NOPAT						−15	−8	21	57	75	73	
Add: depreciation						1.7	1.7	1.7	1.7	1.7	1.7	
Less: change in NWC						19.5	20.9	6.8	2.7	7.8	0.7	−58.3
Equals cash flow from operations	0	0	0	0	0	−33	−27	16	56	69	74	58.3
(A) PV of cash inflows	62.9											
Capital Expenditure	−1.6	−4.3	−2.1	−21.5	−21.5	−22						
(B) PV of costs	−65.5											
NPV = A−B	−2.6					−2.6						

Source: Real Options Group

12.7 Reading the Stock Market

An expectations-based approach to investing starts with a company's stock price and considers what value driver estimates (i.e., growth rate, profit margin, etc.) solve for that price. Using this approach, numerous financial analysts have concluded that many stocks are substantially overvalued. Such an analysis is incomplete because it ignores the potentially meaningful value of imbedded real options.

Stocks of companies that compete in highly uncertain markets are best viewed as a combination of the discounted cash flow value of the current businesses plus a portfolio of real options. This real option can be estimated by taking the difference between the current equity value and the DCF value for the established businesses. Although people may disagree about the value of the imbedded real options, overlooking their existence is a major analytical mistake.

This thinking extends to the issue of volatility. Analysts assume that businesses with numerous real options are extremely volatile because of the risk in their operations. As a result, analysts generally assume higher costs of capital in their discounted cash flow models.

There are two factors at play: the risk in the known businesses and the swings in option value. As noted earlier, option values are very sensitive to changes in underlying asset values and time. So, as expectations about current businesses shift – by extension affecting the options they support – the market values of these companies swing wildly. The resulting high share price volatility speaks more to changes in option value than to current business value.

12.8 Concluding Comments

In this chapter, we described the pitfalls of using the traditional DCF approach to value companies. The DCF methodology breaks down when investments have option-like characteristics. Projects (and hence companies), like options, could have asymmetric payoffs in the sense that the upside might be unlimited while the downside is limited to the initial investment made. It is possible for a project/firm to have many options. One should evaluate them individually and add them up.[6]

The standard DCF model is sufficient for valuing most traditional businesses, but it lacks the flexibility to value many new economy companies. Real options theory, a complement to DCF, adds that necessary flexibility. In the process, real options theory addresses important strategic and financial issues. Although real options analysis has been well understood in the academic community for some time, it will become increasingly important in mainstream security analysis. The primary catalyst is the accelerating rate of change – especially with regard to technology – and the commensurate rise of uncertainty.

[6] This ignores the interaction between the options.

The real options approach provides a powerful framework for thinking about corporate value. It not only allows analytical rigor and business intuition to coexist, but also allows them to thrive.

The following points need to be remembered while executing a real options analysis:

- The estimate of option's volatility has a significant impact on the final value. Due care should be taken in estimating volatility.
- Projects should not be valued using option pricing theory when they do not have option like characteristics! Assume, for example, you have the option to buy something for 90% of its value at any time. Is this an option? Obviously not. You would buy the asset irrespective of when the option is exercised because the option enables you to purchase something for a discount.
- Real options can be classified as exclusive and shared. Exclusive options are unique to the holder. Value arising out of patents is an example. Shared options, on the other hand, are not unique to a company. As the name suggests, they are collectively held by the industry.
- Real options are also of two types – simple and compound. Compound options are options on options.

12.9 End of the Chapter Exercises

1. What are real options?
2. Explain the rationale for applying option pricing theory to investments.
3. Describe the different types of real options.
4. Explain how the Binomial model can be used to price options.
5. Bring out the analogy between Black-Scholes inputs and investments.
6. Can option pricing theory be applied to cable companies (Case study 1 in the text) at all? Can the stealth tier be valued using option pricing theory? Why or why not?
7. Describe the application of real options framework in security analysis.

References

Amram M, Kulatilaka N (1999) Real options: managing strategic investment in an uncertain world. Harvard Business School Press

Amram M, Kulatilaka N (1999) Disciplined decisions: aligning strategy with financial markets. Harvard Business Review

Amram M, Kulatilaka N (1999) Uncertainty: the new rules for strategy. J Business Strategy

Amram M, Kulatilaka N (2000) Strategy and shareholder value creation: the real options frontier. J Appl Corp Finance 13(2)

Brennan MJ, Schwartz E (1992) A new approach to evaluating natural resource investments. In: Stern J, Chew D Jr (ed.) The revolution in corporate finance. Basil Blackwell

Colwell D, Henker T, Ho J (undated) Real options valuation of australian gold mines and mining companies. Working Paper, University of New South Wales
Copeland T, Keenan P (1998a) How much is flexibility worth. The McKinsey Quarterly, No. 2
Copeland T, Keenan P (1998b) Making real options real. The McKinsey Quarterly, No. 3
Copeland T (2001) The real-options approach to capital allocation. Strategic Finance
Copeland T, Antikarov V (2001) Real options: a practitioner's guide. Texere LLC
Courtadon G, Merrick J (1983) The option pricing model and the valuation of corporate securities. Midland Corporate Finance J
Cox J, Ross S, Rubinstein M (1979) Option pricing: a simplified approach. J Financ Econ 7
Damodaran A (2000) The promise of real options. J Appl Corporate Finance 13(2)
Dixit A (1992) Investment and hysterisis. J Econ Perspectives
Dixit A, Pindyck R (1995) The options approach to capital investment. Harvard Business Review
Edelson M (1994) Real options: valuing managerial flexibility. HBS Case No. 9-294-109
Fernandez P (2001) Valuing real options: frequently made errors. Working Paper, IESE Business School
Grenadier S, Weiss A (1997) Investment in technological Innovation: an option pricing approach. J Financ Econ 44
Gompers P (1999) Penelope's personal pocket phones. HBS Case No.9-299-004
Imai J, Nakajima M (2000) A real option analysis of an oil refinery project. Financial Practice and Education
Kemna AGZ (1993) Case studies on real options. Financial Management
Kester CW (1984) Today's options for tomorrow's growth. Harvard Business Review
Kulatilaka N, Venkataraman N (2001) Strategic options in the digital era. Business Strategy Review 12(4)
Leslie K, Michaels M (1997) The real power of real options. The McKinsey Quarterly, No. 3
Luehrman T, Teichner WA (1992) Arundel partners: the sequel project. HBS Case No. 9-292-140
Luehrman T, Wall B (1994) M W Petroleum (A). HBS Case No.9-295-029
Luehrman T (1995) Capital projects as real options: an introduction. Harvard Business School Case No. 9-295-074
Luehrman T (1998a) Investment opportunities as real options: getting started on the numbers. Harvard Business Review
Luehrman T (1998b) Strategy as a portfolio of real options. Harvard Business Review
Paddock J, Siegel D, Smith J (1988) Option valuation of claims on physical assets: the case of offshore petroleum leases. Quart J Econ
Mason S, Merton RC (1985) The role of contingent claims analysis. In: Altman E, Subrahmanyam M (ed.) Recent advances in corporate finance. Richard D Irwin
Mauboussin M (1999) Get real: using real options in security analysis. C S First Boston Research
McDonald R, Siegel D (1986) The value of waiting to invest. Quart J Econ 101
Merton R (1973) Theory of rational option pricing. Bell J Econ Manag
Meulbroek L (2001) Real options valuation when multiple sources of uncertainty exist. HBS Case No. 9-201-106
Moel A, Tufano P (2002) When are real options exercised? An empirical study of mine closings. Review of Financial Studies
Nichols N (1994) Scientific management at merck: an interview with cfo judy lewent. Harvard Business Review
Robichek A, Van Horne J (1967) Abandonment value and capital budgeting. J Finance
Sachdeva K, Vandenberg P (1993) Valuing the abandonment option in capital budgeting – an option pricing approach. Financial Practice and Education
Smit HTJ (1997) Investment analysis of offshore concessions in the Netherlands. Financ Manag 26
Trigeorgis L, Mason S (1987) Valuing managerial flexibility. Midland Corporate Finance J
Trigeorgis L (1993) Real options and interactions with financial flexibility. Financ Manag

Chapter 13
Investing in Initial Public Offerings and Depository Receipts

T. Jithendranathan

13.1 Chapter Introduction and Objectives

Initial Public Offering of equity is a first sale of stock by a private company to the public. IPOs are often issued by smaller, younger companies seeking capital to expand, but can also be done by large privately owned companies looking to become publicly traded.

IPO can be a risky investment for the individual investor because it is hard to predict how the stock will do upon listing and in the long run. Numerous academic studies find that IPOs do well in the short run upon listing and decline in the long run. We review this finding in the chapter on Market Efficiency.

In this chapter, we review the types of public offers, valuation of IPOs, rationale for cross-border listings, and their valuation.

This chapter has the following objectives:

- Review the types of issues and the sources of capital for a firm
- Highlight who invests in a firm at different stages of life cycle of a firm
- Discuss types of IPOs and valuation of IPOs
- Discuss the rationale for cross-border listing

Firms need capital for investing in real assets and this capital is usually raised in the form of debt and equity. Most of the firms are started by entrepreneurs who may initially use their own money or that of a few of their associates to start the firm. Once the firm is established and operational, it will need additional capital. At this point in time, the business is still in its infancy and may not be ready for a full public issue of capital. The following are the two sources of capital a startup firm can tap into.

Angel Investor: Angel investors are mostly high net worth individuals who are willing to invest in startups. Angel investors may provide the seed capital for a

T. Jithendranathan
Opus College of Business, University of St. Thomas, 1000 La Salle Ave, Minneapolis 55403, USA
e-mail: T9JITHENDRAN@stthomas.edu

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_13,

startup firm as well as provide the capital at the growth stage of a new business. According to a study by Mason (2001), during the time period of 1999–2000, of all the investments by angel investors in the UK, 59% went to provide the seed money and initial capital for startup firms. The rest of the money mostly went to expansion of business. This study also noticed that 75% of the angel investments were for £100,000 or less. According to the Center for Venture Research, there were 234,000 active angel investors in the United States in 2006. Some studies indicate that even though the average investment by angel investors are smaller compared to venture capitalists, they invest in ten times more startup firms compared to venture capitalists.

Venture Capital: In many instances, a group of investors called "venture capitalists" will provide additional equity or debt to the startup firm. Venture capitalists specialize in investing in startup firms and are willing to take the risk of the startup may not succeed at all. Venture capital is usually pooled resources of various investors who are willing to take the risk of investing in startups. But once a startup firm establishes itself and is profitable or expected to be profitable, these venture capitalists may like to pull their investments out of the firm. Since the objective of the venture capitalist is to invest in startup firms, once these firms pass the initial stage of growth, they would like to use the money to invest in other startup firms. Similarly, there may be additional capital needed to fund the growth of the startup firm and the original investors may not have the resources to provide the additional capital. All these will lead the firm to raise additional capital.

A firm can raise additional equity capital from two sources – private investors and general public. There are advantages and disadvantages to both types of equity capital. Private equity has less regulatory reporting requirements, but may not be available in sufficient quantity as to meet the capital needs of the firm. It is also possible that depending on the country in which the firm is incorporated, there may be restrictions on the maximum number of shareholders a private firm can have. On the other hand, public equity brings much higher level of regulatory oversight, but will allow the firm to tap into the much larger pool of money available in the capital markets. Another advantage of public issue of equity is that these are usually listed and traded in organized exchanges which provide a much better valuation of the firm.

13.2 Private Placements

In the United States, private placements are exempt from registration under the Securities Act. Private placement or private investment capital is money invested by private investors in the form of stocks and sometimes bonds. In the United States, private placement often does not need to be registered with the Securities Exchange Commission. Regulation D is the most popular form of non-public private placement.

According to Thompson Financial, over US$416 billion was issued in the private placement market for 2002. The majority of those dollars came from pension funds, investment pools, banks, and insurance companies amounting to just over 2,000 deals. Private placement for small business owner is often less expensive and easier than taking your company public.

13.2.1 Benefits of Private Placement

- It allows high degree of flexibility in raising capital with combinations of debt, equity, or debt and equity capital.
- Private placement investors are long-term investors and more patient than venture capitalists.
- Cost of private placement is much lower than approaching venture capitalists or selling the stock to the public as an IPO (Initial Public Offering).
- Quicker form of raising money compared to venture capital.

Even though these private placements are not for sale to public, limited trading takes place in this market. In the United States, Rule 144A under the Securities Act of 1933 establishes rules covering buying and selling of restricted securities. These restricted securities are exempt from the registration requirements under the SEC regulations, but qualified institutional investors are allowed to trade these securities among themselves. Primary motive behind this new rule is to attract more foreign companies to raise funds in the US capital markets.

13.3 Initial Public Offerings Around the World

Following the turning point in calendar 2004, Initial Public Offering (IPO) activity gained momentum for the second successive year in 2005. Overall the total capital raised in IPOs in 2005 (US$167 billion) saw healthy growth while the actual number of deals remained relatively steady (1,537 transactions in 2005 vs. 1,516 in 2004). Interestingly, the absolute quantum of capital raised has now reached levels not seen since the boom days of 2000.

IPO activity continues to reflect the shifting landscape of the world economy with a significant increase in the emerging markets. As testimony to this no fewer than 29 countries – including Brazil, Egypt, Greece, India, Israel, Kazakhstan, Malaysia, Poland, Saudi Arabia, South Korea, and the UAE – each hosted more than $1 billion worth of IPOs last year, marking a globalization trend set to continue through 2006. Initial results for 2006 show an increased interest in markets including South Africa, the Middle East, South Korea, India, and Brazil.[1]

- From an African/Middle East perspective, 2005 was a watershed year for IPO activity primarily on the back of soaring liquidity from oil revenues which

[1] This data are based on a report by Thomson Financial and Ernst and Young.

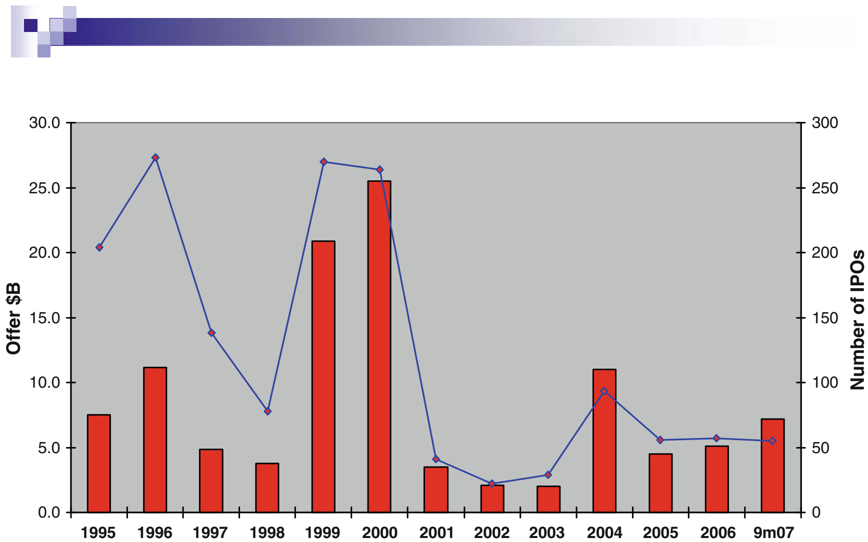
contributed to many big ticket IPOs raising more than $500 million each in the United Arab Emirates (UAE), Saudi Arabia, Oman, Lebanon, and Egypt. The UAE alone saw issues worth $1.9 billion compared to just $0.5 billion in 2004. This trend is, with the necessary political stability, likely to continue with the Middle East becoming a more important source of IPOs as oil revenues are recycled into the local economy/ies.

- Asia continues to be a hotbed of activity. Towed along by mainland China and Hong Kong's continuing strength, other economies in the area displayed vigorous IPO activity, notably Malaysia, Taiwan, South Korea, and India.
- India has evoked lively investor interest and will continue to do so. While the amounts raised fell from $2.9 billion to $2.3 billion in 2005, reflecting fewer privatizations, numbers of transactions surged from 21 to 53.
- Many Indian IPOs have been oversubscribed 20 to 30 times in markets that have been scaling record levels. Following Jet Airways' successful launch – one of the most successful Indian IPOs of recent times – a number of state-run airlines are poised to float in the near future.
- Finally looking at Latin America, Brazil saw an increase in both the amount of capital raised – up 48% to $1.8 billion, and the number of transactions – up 20% on the previous year. Brazilian companies currently account for one-third of all Latin American listings on the New York Stock Exchange.

The IPO activity in the United States has come down drastically during 1995–2007 (see Exhibit 13.1).

In the United States, equity markets are under the supervision of the Securities and Exchange Commission (SEC). All public offerings should be registered with

Exhibit 13.1 IPO activity in the United States



Source: Thomson Financial/National Venture Capital Association the SEC and in the following sections we will look at the process through which a typical IPO issue is carried out.

13.3.1 Valuation

The first step in issuing new equity is to value the firm. This is a very important step for a firm for the reason that if the valuation is wrong, the price at which new equity is sold will be wrong and hence it will be difficult to sell the new equity or it will create a loss for the existing shareholders. In general, most of the firms will seek the help of an investment banker to help them with the valuation of the firm. Since investment bankers may also provide other services, choosing one is the first important step for a firm considering an IPO.

There are several different ways in which a firm can be valued, but almost all of them will be based on the present value of future cash flows generated by the firm. The following is a simple valuation model for a firm using the present value of "free-cash flows." A free-cash flow can be defined as follows:

$$\text{Free} - \text{cash flow} = \text{Net income} + \text{Depreciation} - \text{Additional investments}$$

Additional investments are the increase in working capital and fixed assets needed to keep the firm attaining the necessary revenue targets. The value of a firm then can be then written as follows:

$$V_0 = \sum_{t=1}^{\infty} \frac{(\text{Free-cash flow})_t}{(1+r)^t},$$

where r is the discount rate of the cash flows, which is in fact is the cost of capital of the firm. The above valuation model needs two input variables, the expected future free-cash flows and the appropriate discount rate or cost of capital. In the following sections, we will illustrate the estimation of both using a simple example.

Example 1. New Adventures is a firm that creates computer animation for games that can be played on MP3 players. This is a relatively new market and the firm expects substantial growth in the market. The expected free-cash flows for the next four years are expected to be \$20, \$40, \$70, and \$110 million. After year four the cash flows are expected to grow at a constant rate of 8%. The beta of similar firms is 1.4, market risk premium is 6%, and the risk-free rate is 5%. What is the value of this firm today?

First of all let us find the discount rate, which in this case is the cost of equity,[2] using the Capital Asset Pricing Model.

$$r = 5 + 6 \times 1.4 = 13.4\%.$$

Since the cash flows after year four grow at a constant rate, a constant growth rate model can be used to value the cash flows from that point onwards. The following will be the value of the firm using the discounted valuation model:

$$V_0 = \frac{20}{(1+0.134)^1} + \frac{40}{(1+0.134)^2} + \frac{70}{(1+0.134)^3} + \frac{110}{(1+0.134)^4} + \frac{110(1+0.08)}{(0.134-0.08)(1+0.134)^4} = \$1{,}493.63.$$

The expected value of the firm is approximately \$1.5 billion. If this firm has currently 10 million shares outstanding, the price per share will be \$149.36. If any one of the existing shareholders wants to sell their shares, the fair price per share will be \$149.36. On the contrary, if this firm is thinking of issuing additional shares to raise new capital the issue price should be \$149.36. One of the common mistakes made in practice is to assume that the new issue will dilute the earnings and hence the price of the shares will go down. The assumption is that the new capital will not increase the cash flows, and hence dividing the same cash flows with a larger number of shares will reduce the free-cash flow available to each of the shares. The fallacy of this argument is that if the firm is raising additional capital, it will invest that money in new projects which will increase the cash flows. It is highly unlikely that the managers of the firm will invest in a negative (expected) NPV project!

13.3.2 Determining the Issue Price

Usually, the entire IPO process of a firm is managed by investment bankers. Investment bankers provide a number of valuable services to the firm that is planning to go through the IPO process. As discussed earlier, the first step is to value the firm and usually this is done with the help of investment bankers. Once the valuation is done it is necessary to determine at what price these shares should be sold to the public. Even though valuation models can be used to determine the value of the business, it is not necessary that the potential investors also will have the same valuation as the one made by the firm. If these two prices differ the issue may be either overpriced or underpriced. If it is underpriced, then the existing shareholders will be the losers. If the issue is overpriced, then there will not be any buyers.

[2] Things can get a bit more complicated if the firm is funded by both debt and equity, in which case we need to find the weighted average cost of capital. Also note that the beta of the firm will change if it is levered.

There are three different methods by which the issue prices are fixed. These are fixed-price offering, auctions, and book building.

Fixed price offers: In the case of fixed pricing, the value of a firm is determined by using a valuation model similar to the one discussed in Example 1. Once the total value is determined, then it is divided by the number of shares issued to get the issue price. This method is seldom used in the United States, but used to some extent in European countries. In many Asian countries majority of the IPOs are priced using this method.

Auction: If a firm chooses an auction method to set the issue price, it will use an auction process such as Dutch[3] auction to determine the issue price. Once the auction process is complete, the allocation of shares is made based on the bids. The advantage of this method is that this process will reveal the true demand for the issue as well as the price. This method also allows both large institutional investors as well as small investors to participate in the process. It is also expected that the use of auction process will reduce the potential for underpricing of the issue. Despite its inherent advantages, auction process is seldom used in IPOs. Since the auction process reduces their role in allocation of shares, underwriters generally are wary of auction method. In the United States, the only large issue to use the auction method is that of Google.

Book building: Book building is the most commonly used method of IPO pricing in the United States and increasingly in most of the other countries. In this method, a firm will file an initial prospectus with the regulatory authority indicating the size and indicative price range at which it is planning to issue the shares. Next step is to identify the potential large investors who may be interested in investing in the issue. It is normal for the investment bankers and officers of the issuing firm to go around the major financial centers in the country and present the issue in "road shows." After this initial round of presentations, issuing firm will solicit investor bids on the issue – in terms of both quantities and price. On the basis of investor demand, the issue size and price may be moved up or down. Then a final prospectus will be filed with the issue size and price and allocations are made.

Example 2. New Adventures valuation is approximately US$1.5 billion and currently there are five founding investors, who collectively own 25 million shares and there are five venture capitalists who also own 25 million shares. This gives a value of US$30 per share. Suppose this firm does not want to raise any additional capital, then the entire IPO will come from the existing shareholders. Usually, most of the IPOs will also raise new capital. In this case let us assume that the founding investors will sell 10% of their holding, venture capitalists will sell 60% of their

[3] In a Dutch auction, investors are asked to submit bids for the number of shares and price at which they are willing to buy these shares. Once all the bids are received, they are arranged in the descending order of prices. The shares are allocated first to the highest bidder and then to the next highest, until all the shares are allocated. The price all bidders will pay will be that of the lowest bidder.

holding, and 20 million new shares will be issued. Assuming that the issue price of these shares will be fixed at US$30, the shareholding before and after the issue will be as follows:

	Before	*After*
Founding investors	25.0 million	22.5 million
Venture capitalists	25.0″	10.0″
New shareholders	----	37.5″
Total	50.0″	70.0″

The breakdown of the issue will be as follows:

Sale by existing shareholders	17.5 million
New issue	20.0″
Total	37.5″

13.4 Underwriting

Almost all IPOs in the United States are underwritten by a single or group of underwriters. The role of the underwriter is to guarantee that the issuing firm will be able to sell the new issues at a predetermined price. In effect the underwriters buy the shares from the firm and sell it to the public and give the proceeds minus their commission to the issuing firm. If there is insufficient demand from the public, the shares are held by the underwriters until they are able to find the buyers.

Firm Underwriting: In the case of firm underwriting, the underwriter or the underwriting syndicate will buy all the shares from the issuing firm and will sell it directly to the public. In the case, the issue is undersold the underwriter will have to buy the reminder of the shares and try to sell it at a later date.

Best Effort: In this method, the underwriter or the underwriting syndicate will not guarantee the complete sale of the issue. They will try their best to sell it to the public and if the demand is not there, then the issue will be undersubscribed.

13.5 Allocation

Once the issue price is set, investors are asked to submit their bids for the issue. Once the bids are in the question arises how the shares are allocated. If the issue is oversubscribed (that there are more bids than the number of shares available in the issue), then a decision has to be made on who will get the allocation of shares. There are two major methods by which IPO shares are allocated to shareholders.

Discretionary allocation: In the United States and increasingly in several other countries, investment bankers (underwriters) have full allocation discretion. In this method, the investment bankers have full authority as to who should be getting the allocation of the shares and this information need not be made public. This lack of transparency can be troublesome if it leads to underpricing, which will be discussed later.

Pro rata: In pro rata allocation, the investment bankers have no discretion on who they will allocate the shares to. It will be based on the number of applications and if the issue is oversubscribed, then allocation will be made on a fixed formula to all the applicants who had exceeded a minimum bid threshold.[4]

13.6 Comparison of IPO Process in Various Countries

There is considerable variation in the IPO process among various countries. In UK, the IPO process can be broadly divided into "Placings" and "Public Offers." Placings are not registered issues to the public and are directed towards institutional investors and wealthy individual investors. Allocations in this case are discretionary. Public Offers are invitation to public for subscription and allocations are usually made on a pro rata basis.

German IPO markets are increasingly dominated by book building. Since Germany has several exchanges, each individual exchange can impose restrictions on the IPO allocations as a part of their listing requirement. The fundamental principle behind these allocation rules is to ensure a fair allocation.

Among the emerging markets, Indian IPO markets have seen increasing use of book building. According to the rules of Securities and Exchange Board of India (SEBI), a minimum of 25% of the issue should be made available to the public and the rest can remain with the promoters of the issue. For larger issues, this proportion has been reduced to 10%. The net result of this process is that relatively small proportion of the issue is listed in the secondary market, and this can lead to potential manipulation of the prices.

In China, there are five classes of shares and only some are available for public issue. These classes of shares are (1) government shares, held by the State Asset Management Bureau; (2) legal entity shares (C shares), held by other state-owned enterprises; (3) employee shares; (4) ordinary domestic individual shares (A shares), which can only be purchased by Chinese citizens; (5) foreign shares, which can be purchased by foreign investors in Mainland China (B shares), in Hong Kong (H shares), and in New York (N shares). The new share issue quota in China is determined on an annual basis by the various government agencies and for a period of time these agencies also fixed the IPO price using earnings multiples.

13.7 Underpricing

If the investment bank does the valuation as well as underwriting of the issue, is it to their benefit to place a conservative valuation on the issue? The debate on this issue is still not settled completely, but there is sufficient evidence that on the average there is an underpricing of IPOs in the United States and several other countries.

[4] This minimum threshold is to reduce the allocation to large number of small investors.

If the demand for the IPO among the investors is very high it is called a "hot issue." Such hot issues are hard to get for ordinary investors. The reason for this is the way the shares are allocated by the underwriters. In the United States, underwriters have the discretion to distribute the issue to who ever they choose to do so. In the case of a "hot issue," underwriters will favor their best customers by allocating the issue. Such hot issues may fetch a premium in the secondary market.

If a firm makes a public issue, it will also get the permission to trade the stock on one of the exchanges. The true value of the IPO is revealed when the shares trade on an organized exchange. Investors who were unable to get the initial allocation will try to buy the shares in the secondary market as soon as it is available. Hence the price at which the shares traded in the secondary market will give an indication on the accuracy of the valuation done by the investment bankers. If the price of the shares at the closing of the first day is greater than the issue price, then the IPO is considered to be underpriced. The following example will illustrate this.

Example 3. Continuing with the example of New Adventures, let us assume that the direct of the issue including the filing fees, underwriting fees, etc., adds up to 5% of the total issue proceeds. The issue price of the stock was US$30, but at the end of the day, the stock was trading at US$35. The direct and indirect costs of the issue can be calculated as follows:

Direct cost:
Filing fees, underwriting fees, etc. $= 30 \times 70 \times 0.05 =$ US$105 million

Indirect cost:
Underpricing of the issue $= (35 - 30) \times 70 =$ US$350″

Total cost of the issue = US$455″

Because of the underpricing, the firm lost US$350 million and this will affect both the selling shareholders and the remaining shareholders.

13.8 Raising Capital in Foreign Markets

Why would a domestic firm list its stocks in a foreign market? The most frequently mentioned reason for cross-listing is the need for raising additional capital and diversification of capital sources. However, cross-listing can also have an effect on the return and trading volume of the stock in its home market.

Increasing globalization and investor appetite for diversification offer a unique opportunity to companies looking to tap a new investor base, expand awareness or raise capital. Creating a depositary receipt program gives issuers flexibility and access necessary to achieve strategic goals, while providing investors with an easy and convenient way to invest in companies outside their home markets absent the concerns that normally accompany cross-border investments.

More than 2,000 issuers – from more than 80 markets – have established DR programs and broadened their shareholder base. Depositary receipts account for more than 15% of the entire US equity market, the world's largest and most active capital market. In the United States alone, the level of investment in foreign equities exceeds $2 trillion, reflecting 100-fold growth since 1980.

While depositary receipt programs can be structured in a variety of ways, there are two basic options: American Depositary Receipt programs (ADRs), which give companies outside of the United States access to the US capital markets, and Global Depositary Receipt programs (GDRs), which provide exposure to the global markets outside the issuer's home market. J P Morgan created the first depositary receipt in 1927 for UK retailer Selfridges.

13.9 Definitions

At the most fundamental level, a Depositary Receipt represents ownership of equity shares in a foreign company. These shares are issued against ordinary shares held in custody in the issuer's home market. Although the terms are often used interchangeably, a DR refers to the actual physical certificate while a Depositary Share (DS) refers to the actual shares.

Investors holding DRs are entitled to all economic and corporate rights in accordance with the terms set forth on the DR certificate.

- *DR ratio*: Each depositary share issued represents a certain number of underlying shares held in custody in the issuer's home market. Ratios will vary based upon the share price of the underlying shares and the US share price of other companies in that industry.
- *DR certificate*: Resembling an ordinary share certificate, the DR certificate contains the general terms and conditions of the depositary receipt that apply to DR holders.
- *Trading*: DRs can be listed on a major exchange (e.g., NYSE, AMEX, NASDAQ in the United States; London, Luxembourg, or Singapore outside of the United States). DRs may also be unlisted, and trade in the over-the-counter (OTC) markets, or be privately placed with Qualified Institutional Buyers and trade via the PORTAL system.
- *Settlement*: DRs trade and settle in accordance with market practice in the markets in which they are traded. For example, ADRs (available in the United States) settle via the DTC while Reg S DRs in Europe settle via Euroclear and Clearstream.
- *Currency risk*: Although DR denominations match the currency of the market in which they trade, currency risk associated with investments in foreign companies is not eliminated. The depositary and custodian work closely on the issuance and cancellation of underlying shares and depositary receipts in support of an issuer's depositary receipt program.

- *Issuance and cancellation*: "Issuance" and "cancellation" simply refer to the transfer of custody of the share between the home market and the overseas market. These terms do not refer to the purchase, sale, or trading of the depositary receipt.
- *Liquidity*: Depositary receipts are as liquid as the shares in the home market, because new depositary receipts can be created (or cancelled) as needed based on investor interest. Consequently, the supply of depositary receipts is not constrained by the number of DRs traded at any point in time in the markets where they are available.

13.10 Types of DRs

The flexibility of the depositary receipt structure is one of its most attractive characteristics, and a variety of alternatives have evolved to satisfy the needs of issuers.

ADRs: In the United States, issuers have several types of programs from which to choose: listed on a national stock exchange or traded over-the-counter; available to retail or institutional investors; and designed to expand the issuer's shareholder base or raise capital.

One of the requirements for issuing ADR is that the issuing firm has to follow the US Securities and Exchange Commission's (SEC) guidelines on disclosure. Depending on the level of disclosure and whether the firm is using the ADR to raise new equity, these ADRs are classified into three levels. Level I ADR is the least expensive to issue and has relatively less stringent disclosure requirements, but can only be traded in the over-the-counter (OTC) market in the United States and cannot be used to raise new capital. Level II ADRs are allowed to trade in organized exchanges in the United States, but the issuing foreign firm has to undergo full disclosure requirements as stipulated by SEC and cannot be used to raise new capital. With a Level III ADR, the issuing firm can raise new capital and list the ADR in an organized exchange in United States, but has to provide to the SEC financial statements prepared according to the US Generally Accepted Accounting Principles (GAPP) or submit a detailed summary of the differences in financial reporting between home and the United States.

Rule 144 A market: A foreign firm that would like to raise capital without meeting the full disclosure requirements can do so by using private placements under *Rule 144A* of SEC. These private placements have a limited secondary market; only Qualified Institutional Investors[5] (QIBs) are allowed to trade these private placements. One of the other developments in the 144A market is the creation of Global Depositary Receipts (GDRs). Some of the US private placements are issued for global investors and then traded in markets outside the United States, predominantly

[5] A QIB is defined as a firm that has at least US$100 million available for investments. Currently there are 4,000 QIBs and they trade on the 144A placements using the closed electronic system called PORTAL (Private Offerings, Resales and Trading through Automated Linkages).

Exhibit 13.2 Salient features of different types of DR offerings

Program type	Listed on NYSE, AMEX or NASDAQ	Unlisted	Retail investors	Institutional investors (QIBs)	Broaden shareholder base	Raise capital
Level 1 unlisted OTC		Yes	Yes		Yes	
Level 2 listed	Yes		Yes		Yes	
Level 3 listed	Yes		Yes			Yes
Rule 144 A				Yes		Yes

in London and several German exchanges. These DRs for sale outside the United States are issued under Registration S provision, and can be complementary to a 144A issue in the United States. One of the major differences between ADRs and GDRs is that these GDRs are usually listed in a foreign exchange, but cannot be bought and sold by US citizens.

GDRs: Issuers who look beyond the US equity markets to raise capital typically do so using a GDR, which commonly combines two complementary structures: the Regulation S (Reg S) depositary receipt and the American Depositary Receipt (ADR). The most frequently utilized structure is a RegS/Rule 144A DR, which raises capital in the European markets (typically London or Luxembourg) and through private placement with qualified institutional buyers in the United States. The inherent flexibility of GDRs is one of its most attractive characteristics, however, and Reg S DRs can be combined with either Level 1 (unlisted) or Level II/II (listed/listed with IPO), depending upon the issuer's needs.

- Issuers should carefully assess their business goals in order to select the right depositary receipt structure. Consider whether the objective is to
- Expand the investor base or raise capital.
- Increase liquidity and recognition in the United States or in other markets.
- Attract retail or institutional investors.
- The salient features of different types of DR offerings are presented in Exhibit 13.2.

13.11 Rationale for Cross-Listing

One of the main motivations for a firm for cross-listing is to raise new capital. Level III ADRs and private placements can be used in achieving this goal. But the benefit of issuing Level I or Level II ADRs, where no additional capital is raised, is more difficult to measure. Mittoo (1992) surveyed corporate managers and found that increased liquidity is the main reason for cross-listing stocks. Firms from countries with small and illiquid capital markets can use cross-listing to increase the liquidity of their stocks. The following are some of the theoretical and empirical literature on the economic effects of cross-listing.

Cross-listing of stocks broadens the ownership basis of firms. In many countries foreign investors are allowed to participate directly in the domestic stock markets. But difficulties with accessing the information and conducting timely transactions restrict the participation to mainly large institutional investors. Cross-listing also allows non-institutional investors to buy the stock of these firms. The study by Ahearne et al. (2004) showed that the US investors hold 17% of the outstanding stock of the cross-listed firm, which is 14% higher than those firms that are not cross-listed. Lins et al. (2004) show that cross-listing and raising new capital also allows the firms to be less dependent on the borrowed capital.

Having a group of stockholders who are outside the jurisdiction of the country of domicile of the issuing firm can have a certain restraining effect on the behavior of the managers of the issuing firm. Cross-listing can be construed as a signal by the issuing firm's managers that they are willing to "bond" themselves to not take private benefits from the firm, in exchange for access to the external markets. Coffee (1999, 2002) suggests that listing in US brings the firm under the enforcement powers of the SEC and any violations of the rules can result in legal proceedings against the firm and its managers. This potential for legal actions can have a restraining effect on the managers and hence can reduce the agency cost. The study by Doidge et al. (2004) provides some empirical evidence to the bonding hypothesis. For the year 1977, they found that the cross-listed firms enjoyed a 16% "cross-listing premium" over similar non-cross-listed firms around the world.

13.12 DR Indexes

Just as there are equity and bond market indexes, there are also DR indexes maintained by companies like J P Morgan. These indexes represent an ideal way for retail and institutional investors to benchmark performance of their international equity holdings. Additionally, institutional investors and fund managers can structure products based on these indexes (designed to include highly liquid components).

J P Morgan maintains three types of indexes – composite, region, and sector. The following are the different indexes:

1. DR composite indexes

    J P Morgan Depository Receipt Emerging Markets Composite Index
    J P Morgan Depository Receipt Composite Index
    J P Morgan Global Depository Receipt Composite Index

2. DR region indexes

    J P Morgan DR Brazil, Russia, India, China (BRIC) 50 index
    J P Morgan DR China 25 index

J P Morgan DR Developed markets 100 index
J P Morgan DR Emerging markets 100 index
J P Morgan DR Korea, Taiwan, India 25 Index
J P Morgan DR Latin America 30 Index

3. DR sector indexes

J P Morgan DR Financial 25 Index
J P Morgan DR Oil, Gas, and Mining 25 index
J P Morgan DR Technology, Media, and telecommunications 75 index

Exhibits 13.3–13.11 present statistics on the DR market.

13.13 Concluding Comments

In this chapter, we reviewed both initial public offering of shares in the domestic market as well as the issue of securities outside the country. IPOs attract a lot of attention by both investors and researchers because of rampant underpricing of shares in the short run and overpricing in the long run.

Investors in IPOs must be aware of the empirical findings on the short- and long-run behavior of IPO returns.

The valuation of shares in a cross-border context is just an extension of its domestic counterpart. A few modifications need to be made to the valuation framework:

- The domestic cost of capital is to be replaced by a global cost of capital for the company
- Cash flows are to be specified in the same currency as the discount rate
- The PV of cash flows are to be converted into the home currency and the price per share is determined both in the home and in the host country currencies

Exhibit 13.3 Issuers with the most widely held programs

Issuer	Total invested ($ Millions)
América Móvil, S.A. de C.V.	35,412.83
PETROBRAS - Petroleo Brasileiro S.A.	33,907.19
Nokia Corporation	30,363.42
BP p.l.c.	27,717.28
PETROBRAS - Petroleo Brasileiro S.A.	22,609.83
Royal Dutch Shell Plc	21,196.29
Teva Pharmaceuticals Industries Ltd.	19,609.89
Companhia Vale do Rio Doce	18,608.17
Companhia Vale do Rio Doce	16,633.94
Vodafone Group Plc	15,451.07

Source: J P Morgan

Exhibit 13.4 DR Trading data as of April 3, 2008

Today		Total
Share volume (000s):		1,179
Value of trading (Million of $US)		16
Issues up:		1
Issues down:		10
Issues unchanged:		456
Year to Date	**Total**	**Avg Daily**
Share volume (000s):	25,612,382	333,003
Value of trading (million of $us)	1,049,516	16,688
Issues up:	167	
Issues down:	336	
Issues unchanged:	33	

Source: J P Morgan

Exhibit 13.5 Top 10 DRs by volume

Security	$ Value (MM)	Volume
OJSC Rosneft	8.01	874,580
JSFC Sistema	4.45	136,195
ASM	1.24	96,322
Chinatrust Financial	2.00	69,522
Guaranty Trust Bank	0.01	1,500
Eurasia Drilling Co	0.03	1,000
Nokia	0.00	300
CCU	0.00	0
AXA	0.00	0
BIC	0.00	0

Source: J P Morgan

Exhibit 13.6 Top 10 DRs by $ value

Security	$ Value (MM)	Volume
OJSC Rosneft	10.76	1,176,354
JSFC Sistema	5.78	176,481
Chinatrust	2.00	69,522
ASM	1.49	115,669
BHP Billiton	0.07	1,500
SAP	0.05	1,000
Sasol	0.05	1,900
Eurasia Drilling Co	0.03	1,000
Guaranty Trust bank	0.01	1,500
CCU	0.00	0

Source: J P Morgan

Exhibit 13.7 Top sectors

Industry	Number of companies	6 Month return (%)	12 Month return (%)	YTD return (%)
Advertising	3	−2.69	−2.65	−2.59
Aerospace	4	−2.37	−1.65	−2.30
Airline	10	−2.94	−2.55	−2.77
Apparel/textile	10	−2.35	−2.04	−2.70
Automotive	16	−2.64	−2.01	−2.33
Beverage	13	−1.65	2.72	1.84
Biotechnology	1	−3.13	−2.81	−3.06
Chemicals/Petrochem	16	−1.80	3.26	−2.04
Computer Hardware/Software	20	−2.22	2.30	−2.57
Construction	12	−2.27	2.63	2.26
Consumer Products	4	−2.25	2.58	−2.33
Electronics	14	−2.68	−2.54	−2.63
Foods/Agribusiness	21	2.05	1.56	−2.11
Healthcare	10	−2.55	1.89	−2.35
Household products	1	−3.01	−3.19	−2.82
Insurance	11	−2.52	1.87	2.00
Internet	10	−1.90	3.03	−1.81
Investment Holding	8	−2.12	2.59	−1.94
Machinery	10	−2.34	2.59	−1.88
Media/Entertainment	13	−2.48	−2.19	−2.25
Conglomerate	22	2.05	2.97	2.26
Office equipment	9	−2.48	2.38	−2.23
Paper and forest	2	−2.78	−2.52	−1.88
Packaging	9	−2.72	−1.73	−2.33
Personal care	2	2.48	2.88	1.88
Pharmaceuticals	19	−2.44	−2.52	−2.29
Publishing	1	−2.53	−2.81	−2.22
Real Estate	12	−2.62	1.78	−2.19
Resorts	12	−2.78	−2.84	−2.52
Retailing	4	−1.92	2.87	−1.96
Services	10	2.26	3.02	−2.09
Steel	7	−2.58	−2.29	−2.47
Transportation	26	−2.27	2.28	−2.25
Utilities	78	−2.38	2.40	−2.34
Telecom	73	2.65	2.62	−2.00
Financial services	23	−2.66	−2.6	−2.09
Electrical equipment	44	−2.4	2.65	−2.45

Exhibit 13.8 Top countries

Country	Number of companies	6 Month return (%)	12 Month return (%)	YTD return (%)
Argentina	15	−2.29	−2.35	−2.32
Australia	10	−2.51	2.50	−1.90
Brazil	42	−2.16	2.77	−1.64
Chile	14	−1.50	2.74	2.51
China	39	−2.83	2.70	−2.76
Colombia	2	1.89	2.73	2.06
Denmark	3	1.79	2.58	1.67
Finland	4	−2.83	−1.78	−2.46
France	32	−2.51	2.63	−2.43
Germany	28	−2.44	2.48	−2.53
Greece	3	−2.66	2.34	−2.74
Hong Kong	10	−2.33	1.63	−2.47
Hungary	3	−2.54	2.12	−2.38
India	17	−2.56	2.39	−2.87
Indonesia	2	−2.83	2.03	−2.55
Ireland	8	−2.20	−1.42	1.97
Israel	5	2.10	2.74	−2.03
Italy	12	−2.79	−2.76	−2.72
Japan	49	−1.95	−2.28	2.28
Korea	17	−2.82	−2.25	−2.60
Luxembourg	3	−2.05	2.08	2.23
Mexico	20	−1.81	2.30	2.24
Netherlands	21	−2.43	2.03	−2.45
Nigeria	2	0.00	0.00	0.00
Norway	7	−2.54	2.59	−1.63
Philippines	4	−2.78	2.77	−2.77
Poland	2	−2.70	2.65	−2.68
Portugal	2	−2.17	2.04	−2.31
Russian Fed	34	−1.71	2.57	−2.48
Singapore	5	−2.56	−2.43	−2.39
South Africa	11	2.24	2.73	2.29
Spain	8	1.9	2.24	−1.95
Sweden	5	−2.79	−2.66	2.14
Switzerland	12	1.43	2.42	2.06
Taiwan	10	1.92	2.50	2.05
Thailand	1	2.19	2.93	2.80
Turkey	1	2.03	3.29	−2.76
UK	76	−2.57	−2.36	−2.22
Ireland	4	3.88	3.86	2.92

Exhibit 13.9 Top 10 holders of DRs

Name	Value ($mm)	% Port	Turnover
Marsico Capital Management, L.L.C.	1,402.93	1.74	Mod
Fidelity Management & Research	1,092.90	0.18	Mod
Dodge & Cox	808.43	0.64	Low
AllianceBernstein L.P.	653.79	0.22	Mod
Greenhaven Associates, Inc.	530.80	15.21	Mod
Wellington Management Company, LLP	394.17	0.13	Mod
Delaware Investments	358.99	0.83	Mod
Fisher Investments	347.56	0.91	Low
Renaissance Technologies Corp.	225.04	0.39	High
Michigan Department of Treasury	172.03	0.68	Mod
Top 10 holders total value $		5987m	
Total value $	10,410 m		

Exhibit 13.10 Top 5 buyers of DRs

Name	Value ($mm)	Turnover
J.P. Morgan Securities Ltd.	79.93	High
Capital Research and Management Company	142.50	Low
Thornburg Investment Management, Inc.	140.78	High
INVESCO Capital Management Inc.	101.67	Mod
Ariel Capital Management, LLC	32.76	Mod

Source: J P Morgan

Exhibit 13.11 Exhibit 13.11 Top 5 Sellers of DRs

Name	Value ($mm)	Turnover
Marsico Capital Management, L.L.C.	1,402.93	Mod
Dodge & Cox	808.43	Low
Renaissance Technologies Corp.	225.04	High
Van Kampen Asset Management Inc.	140.23	Mod
Barclays Global Investors (UK) Ltd.	65.53	Mod

Source: J P Morgan

13.14 End of the Chapter Questions and Exercises

1. Compare and contrast fixed price offers, auctions, and book building.
2. How is the price of an initial public offering of shares determined? Explain.
3. What are the two types of underwriting?
4. What is underpricing of IPOs and how does it affect investors?
5. Explain the rationale for cross-listing.
6. What are the different types of depository receipts?
7. Compare and contrast the different types of listing in the United States.

References

Ahearne A, Griever W, Warnock F (2004) Information costs and home bias: an analysis of US holdings of foreign equities. J Financ Econ 62:313–335

Alexander G, Eun C, Janakiraman S (1988) International listings and stock returns: some empirical evidence. J Financ Quant Anal 23

Coffee J (1999) The future as history: the prospects for global convergence in corporate governance and its implications. Northwestern University Law Review 93:641–708

Coffee J (2002) Racing towards the top? the impact of cross-listings and stock market competition on international corporate governance. Columbia Law Review 102:1757–1831

Doidge C, Karolyi GA, Stulz R (2004) Why are foreign firms that are listed in the U.S. worth more? J Financ Econ 71:2005–2238

Domowitz I, Glen J, Madhavan A (1998) International cross listing and order flow migration: evidence from an emerging market. J Finance LIII(6)

Foerster SR, Karloyi A (1999) The effects of market segmentation and investor recognition on asset prices: evidence from foreign stock listing in the US. J Finance

Karloyi GA (1998) Sourcing equity internationally through depository offerings: two exceptions that prove the rule. J Appl Corporate Finance 10(4)

Lins K, Strikland D, Zinner M (2004) Do non-U.S. firms issue equity on U.S. exchanges to relax capital constrains? J Financ Quant Anal

Mason C (2001) Report on business angel activity 1999/2000. British Venture Capital Association, London

Miller D (1999) The market reaction to international cross listings: evidence from depository receipts. J Financ Econ 51

Mittoo U (1992) Managerial perceptions of the net benefits of foreign listing: evidence from depositary receipts. J Int Financ Manag Account 4:40–62

Chapter 14
Pricing Equity Options

Ravishankar Mateti

14.1 Chapter Introduction and Objectives

The use of derivatives both by companies and investors has increased exponentially over the last 20 years. Equity options are commonly used by investors in addition to positions in the underlying equity. In this chapter we review the following:

- Pay-off profiles of various options strategies
- Pricing of European-type and American-type options for both dividend paying and nondividend paying stocks using (a) Black–Scholes and Merton models, (b) Binomial method, and (c) option pricing calculators

R. Mateti
Charlton College of Business, University of Massachusetts, Dartmouth, 285 Old Westport Road, 2747 North Dartmouth MA, USA
e-mail: rmateti@umassd.edu

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_14,

Warren Buffet on Derivatives

Edited Excerpts from the Berkshire Hathaway Annual Report for 2002

I view derivatives as time bombs, both for the parties that deal in them and for the economic system. Basically, these instruments call for money to change hands at some future date, with the amount to be determined by one or more reference items, such as interest rates, stock prices, or currency values.

The derivatives genre is now well out of the bottle, and these instruments that will almost certainly multiply in variety and number until some event makes their toxicity clear. Central banks and governments have so far found no effective way to control, or even monitor, the risks posed by these contracts. In my view, derivatives are financial weapons of mass destruction, carrying dangers that, while now latent, are potentially lethal.

The excerpts from Warren Buffet's letter in the Berkshire Hathaway Annual Report summarize the enormous interest derivative instruments have received. Derivative instruments, in their modern form, are relatively new. Futures contracts that allow traders to buy and sell commodities at a future date for a price-set now started in the USA in the 1920s with the setting up of the clearinghouse, although a crude form of futures trading of commodities was in vogue as far back as the eighteenth century.

14.2 Option Pay-Off Profiles

Derivative contracts can be broadly classified as forward commitments and contingent claims. Forward contracts, futures contracts, and swaps come under forward commitments whereas options are contingent claims. Contingent claims derive their name from the fact that their value depends on the value of another underlying instrument. Options on stocks, for example, derive their value from the value of the underlying stock. Forward commitments, as the name itself suggests, allow parties to fix the price of a commodity to be exchanged some time in future. Futures contracts on wheat, for example, allow traders to buy or sell wheat at some point in future for a price determined now. The exchange on which the contract trades determines the expiration dates of the contract, settlement price, and such other terms of the contract.

Derivative instruments can be either exchange-traded (e.g., options) or contracted over the counter (e.g., currency forward contracts). We focus on options in this chapter because they are found everywhere – in financial instruments, projects, and contracts.[1] We intend to provide a lucid overview of option pricing in this chapter. The next chapter reviews evidence on options, including volatility, a key determinant of option prices.

An option gives the holder the *right*, but not the obligation, to buy or sell a designated asset (e.g., stock, currency, commodity, etc) at a predetermined price. There are two types of options. A *call* option gives the holder the right to buy the underlying asset by a certain date for a certain price. A *put* option gives the holder the right to sell the underlying asset by a certain date for a certain price. The contract price is known as strike price or exercise price; the date in the contract is known as expiration date. *American* options can be exercised at any time up to maturity and *European* options can be exercised only at maturity. The asset underlying option contracts could be stocks, stock indices, foreign currency, debt instruments, commodities, etc. For stock options, the underlying asset is stock. Each contract is for a fixed number of units of the underlying asset. In case of equity options, it is 100 shares. The buyer of the option pays the seller a premium for enjoying the right

[1] A description of Equity Option and LEAPS contract traded on the Chicago Board Options Exchange is provided in the appendix to this chapter.

(but not the obligation). Call options have value if the price of the underlying asset is more than the exercise price because the holder of the contract can exercise his option to purchase and sell the asset for a higher price in the market. If the price of the asset is less than exercise price, the option expires worthless and the buyer of the option loses his premium. That is,

$$\text{Value of call option on the expiration date} = \text{Max}[S - X, 0].$$

Exhibit 14.1 presents the call option quote on International Business Machines (IBM) stock as of 31 August 2007. The table presents the call option premium on that day for at-the-money options on IBM stock for various expiration dates like September 2007, October 2007, January 2008, and April 2008.

Exhibit 14.2 presents the put option premium for at-the-money options on IBM stock.

The option is worthless as long as the strike price exceeds the exercise price by an amount equal to the premium paid. The pay off can be plotted on a diagram as shown in Exhibit 14.3.

The maximum that an option holder loses is the premium paid, whereas the upside potential is unlimited. The value of the option increases one-to-one for any increase in price above the break-even price. Since each option is for 100 shares, the strike price, exercise price, and the premium have to be multiplied by 100 to arrive at the aggregate pay off. If the holder of the option decides to exercise the option, he should pay Rs. 180×100 (i.e., exercise price $\times 100$ shares). Those options worth exercising are called in-the-money and those that are not are considered out-of-the-money.

The pay off from the perspective of a seller is given in Exhibit 14.4.

Note that the seller (writer) of the call option gets the premium as long as the strike price is lower than the exercise price. While the upside is fixed, the downside

Exhibit 14.1 International Business Machine (*IBM*) Calls as of August 31st, 2007

$S = 116.69$ (in \$)						
ATM calls for various expiration dates as of August 31st, 2007						
Type	Strike	Exp date	Option volume	Open interest	Bid price	Ask price
ATM	115	Sep 07	2327	11,052	3.4	3.5
ATM	120	Sep 07	1477	9,629	0.85	1.0
ATM	115	Oct 07	759	9,985	5.3	5.5
ATM	120	Oct 07	471	7,664	2.55	2.75
ATM	115	Jan 08	276	13,893	8.5	8.8
ATM	120	Jan 08	230	17,321	5.8	6.0
ATM	115	Apr 08	35	681	10.8	11.1
ATM	120	Apr 08	99	363	8.1	8.4

Source: www.volatilityworks.com

Exhibit 14.2 ATM puts for various expiration dates as of August 31st, 2007

Type	Strike	Exp date	Option volume	Open interest	Bid price	Ask price
ATM	115	Sep 07	1650	5014	1.35	1.45
ATM	120	Sep 07	505	2090	3.7	4.1
ATM	115	Oct 07	762	8260	2.8	3.0
ATM	120	Oct 07	15	785	5.1	5.3
ATM	115	Jan 08	8	2711	5	5.3
ATM	120	Jan 08	18	3128	7.3	7.6

Source: www.volatilityworks.com

Exhibit 14.3 Pay-off profile of a long call option position

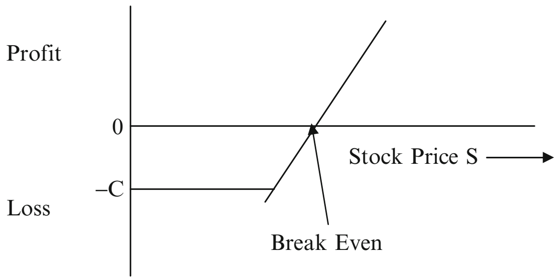
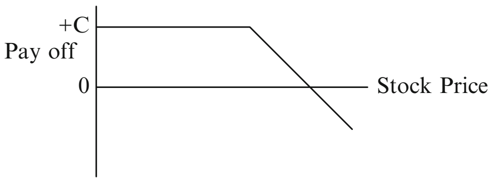


Exhibit 14.4 Pay-off profile of a short call position



is unlimited. Also note that the pay offs are mirror images – what the buyer gains the seller loses and vice versa. That is, they sum to zero.

A put option, as opposed to a call option, gives the holder an option to sell a fixed amount of the underlying asset at a fixed price. As in the case of call option, the buyer of the put option pays a premium to the seller. A put option has value if the stock price is less than the exercise price. That is, the holder can purchase in the open market at a lower price and deliver it to the seller at the (higher) exercise price.

Value of put option on the expiration date $= P = \max(0, X - S)$

The pay off to a *long* put option position is given in Exhibit 14.5.

Note that the buyer of the put option makes money if the ending spot price of the underlying asset is lower than the exercise price. Likewise, the pay off to the writer of a put option is given in Exhibit 14.6.

Exhibit 14.5 Pay-off profile of a long put position

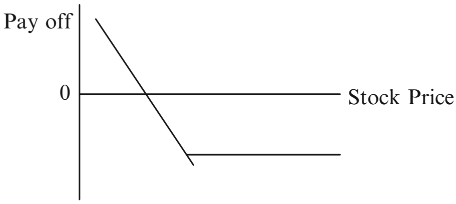
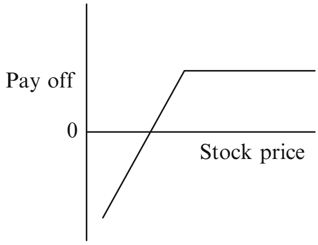


Exhibit 14.6 Pay-off profile of a short put position



Like call options, the pay off for the put option holder and writer sum to zero. An investor may combine these four positions to create a number of options strategies. For example, one may buy the underlying asset and sell a call option on the same asset. This strategy is known as covered call write.

As mentioned earlier, there are two types of options – American and European. American-type options can be exercised before expiration, while European-type options can be exercised only upon maturity. Since American options have all rights that European options have and the right to exercise early, an American option is at least as valuable as the European option.[2] Option values cannot be negative. They can at worst be zero since options provide the right but not the obligation to exercise.

14.3 Determinants of Option Prices

The value of call option on a nondividend paying stock is dependent on five factors viz. stock price, exercise price, term to maturity, risk-free rate, and volatility of stock price. The impact of these factors is discussed below.

The value of the call option increases as the asset price increases because a higher current asset price makes it more likely that on the expiration date the market price of the asset will be above the exercise price. Likewise, lower asset prices make the put option more valuable.

[2] American options are more valuable than European options if the right to exercise early is valuable.

Exhibit 14.7 Impact of changes in option pricing variables on the price of an European option

Variable	Call	Put
Asset price	↑	↓
Exercise price	↓	↑
Maturity	↑	?
Volatility	↑	↑
Interest rates	↑	↓
Dividends	↓	↑

A higher exercise price makes a call option less valuable and a put option more valuable.

If the variability of asset prices is high then the chances of large gains are also high. The holder of the option contract benefits from upside potential but has a limited downside (equal to the premium). So increases in volatility have a favorable impact on option prices.

Similarly, a longer time to maturity has a favorable impact on option prices because the probability of ending up in-the-money becomes larger. At the same time the present value of exercise price decreases. In case of call options, the decrease in present value of exercise price augments the positive time effect of increased uncertainty and the value goes up. For a European put option, the net impact of these two effects is not known; the former increases the value of the option whereas the latter decreases.

An increase in the risk-free rate of interest lowers the present value of the exercise price paid on the expiration date. For a call option this means a lower payment (in present value terms) for the asset if the option is exercised and the call option is therefore worth more. The converse is true of put options.

An increase in dividends reduces future asset prices, which reduces the profit opportunity for the holder of a call option. Consequently, the value of call option reduces with increases in dividends. The opposite is true for put options.

The impact of an increase in any of these variables on European-type call and put option values is presented in Exhibit 14.7.

14.3.1 Pricing Options Using Option Tables

A call option should be exercised if the stock price exceeds the strike price at expiration. That is if $S > X$. For the sake of convenience let us express it as a ratio. The option has value if $S/X > 1$. If S/X is less than 1, the option should not be

Exhibit 14.8 Option pricing table

Share price/PV of exercise price	Option value (%)			
	Annual σ^* Square root of time			
	0.25	0.5	0.75	1.0
0.5	0	3	10	19
0.6	0	5	14	24
0.7	1	8	18	28
0.8	3	12	22	32
0.9	6	16	26	35
1.0	10	20	29	38

exercised as it is out of the money. The variability (per unit of time) of returns is measured by variance. Multiplying the variance per unit of time by amount of time to maturity gives the cumulative variance. The higher the cumulative variance, the more valuable is the option. The value of a European call option as a percent of value of underlying asset is available in a table form to make our life simple (like the time value of money tables). A portion of the same is presented in Exhibit 14.8.[3]

Consider the following data:

Stock price $= \$50$
Annual volatility $= 25\%$
r_f $= 5\%$
Exercise price $= \$60$
T $= 4$ years

PV of exercise price $= 60/(1.05)^4 = 49.36$
Share price/PV (X) $= 50/49.36 = 1.01$
$\sigma(\sqrt{}4)$ $= 25\% \times 2 = 50\%$

The cell at the intersection of row 6 and column 2, 20%, gives the call option value as percent of value of underlying asset. Option value $=$ 20% of stock price $= 0.2 \times \$50 = \$10$.

14.4 The Relationship Between Call and Put Option Prices

Assume that you have purchased a European call option and sold a European put option on the same asset (S) with the same exercise price, X, and expiration date (like those on the IBM stock).

[3] See Table of Exhibit **??** at the end of the chapter.

The investment required to establish this position is the difference between call and put values. The purchase of call option needs an investment of C, which is partly offset by the premium received from the put purchaser.

That is, investment requirement $= C - P$.

The pay off to this position is $S - X$. On the expiration date if the spot price is more than the exercise price, the call option will be exercised but the put option expires worthless. But if the spot price is less than the expiration price, the call option expires worthless and the put option will be exercised against the position. Consequently, the pay off will be negative.

Consider another investment in which an investor borrows the present value of X to purchase the asset. The investment required is

$$= S - \frac{X}{(1+r)^T},$$

and the pay off to this position on the expiration date, T, is $S - X$ since the investor owns the asset (S) and owes X.

Since the pay off to these two investment positions is the same, their initial investment must also be the same to prevent arbitrage opportunities.

$$\begin{aligned} C - P &= S - \frac{X}{(1+r)^T}, \\ &= S - \text{PV of } X. \end{aligned}$$

Rearranging terms,

$$P = C - S + \text{PV of } X.$$

This property is known as put–call parity.

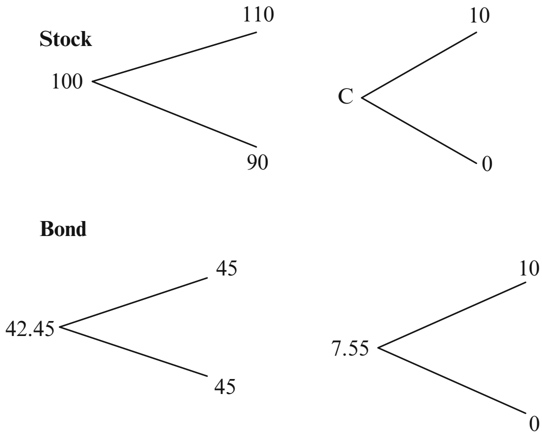
14.5 Equity Option Pricing: The Single-Period Binomial Model

Assume that the current price of a stock is \$100. Assume that can go up by 10% to 110 or fall by 10% to 90 in 1 year. The risk-free rate is 6%. Call and put options trade on this stock at an exercise price of \$100. The call must be worth \$7.55 and put must be worth \$1.89. Let us see why.

Exhibit 14.9 presents the pay off on the stock and bond position in 1 year. The value of the call option at expiration is the maximum of 0 and the difference between stock price and exercise price. That is, the call option will be worth \$10 or 0 depending on whether the stock goes up or not.

The binomial option pricing model is based on the insight that the option can be replicated by a portfolio of a position in stock and risk-free bond whose value replicates that of the option. Consider a portfolio consisting of one-half share of

Exhibit 14.9 One-period pay-offs



stock plus a short position in a risk-free bond that matures in 1 year and has a purchase price of \$42.45. In 1 year, the portfolio value depends on the stock price. Half share will be worth 55 or 45 depending on whether the stock price is \$110 or \$90. In either event, we owe 45 to repay the bond. If the stock rises, the portfolio is worth \$10. If the stock price falls, the portfolio is worth zero. These are exactly the payoffs on the call option. Since their payoffs are same the initial value must be the same to prevent arbitrage. Therefore, the value of the portfolio must be equal to that of the call.

That is, the price of a European call option,

$$\mathrm{C}_t = \mathrm{NS}_{t-B} = 0.5\,\mathrm{S}_t - 42.45 = \$50 - \$42.45 = \$7.55.$$

Let us generalize the result. The value of the portfolio $= \mathrm{NS}_t - \mathrm{B}_t$.

The value of the portfolio in the "up" state is $\mathrm{NUS}_t - \mathrm{RB}_t$ where $U = 1+$ percentage of stock price increase and $\mathrm{R} = 1 + r$.

The value of the portfolio in the "down" state is $\mathrm{NDS}_t - \mathrm{RB}_t$ where $D = 1-$ percentage of stock price decrease. These values must equal the values of call option in the up and down states, respectively.

$$\mathrm{C}_u = \mathrm{NUS}_t - \mathrm{RB}_t \tag{14.1}$$

$$\mathrm{C}_d = \mathrm{NDS}_t - \mathrm{RB}_t \tag{14.2}$$

There are two equations and two unknowns N and B. Solving these equations we get

$$\text{No. of shares} = N = \frac{\mathrm{C}_u - \mathrm{C}_d}{(U - D)\,\mathrm{S}_t},$$

or, the ratio of number of shares in the replicating portfolio to the number of shares underlying the option contract, called hedge ratio, h, is given by

$$h = \frac{\mathrm{C}_u - \mathrm{C}_d}{\mathrm{S}_u - \mathrm{S}_d},$$

and the value of bond $B_t = [\mathrm{C}_u D - C_d U]/(U - D)R$.

Therefore, $C_t = N \times S_t - B_t$.

In the previous example, the values of call option in the upstate and downstate are \$10 and 0, respectively.

That is $C_u = 10, C_d = 0, U = 1.1, D = 0.9, r = 1.06$.

Substituting these values we get

$$B = \frac{[10(0.9) - 0(1.1)]}{(1.1 - 0.9)(1.06)} = 42.45,$$

$$N = \frac{[10 - 0]}{(1.1 - 0.9)100} = 0.5.$$

Note that we have not explicitly assigned probabilities to these states. Further, the model assumes that investors are risk neutral. That is, they have no preference for payoffs on the basis of probabilities.

The value of call option can be written as

$$C_t = \frac{(\mathrm{C}_u - \mathrm{C}_d)}{(U - D)S_t} \quad S_t - \frac{\mathrm{C}_u D - \mathrm{C}_d U}{(U - D)R}$$

or

$$C_t = \left[\frac{(\mathrm{C}_u - \mathrm{C}_d)}{(U - D)}\right] - \left[\frac{\mathrm{C}_u D - \mathrm{C}_d U}{(U - D)R}\right].$$

Isolating C_u and C_d we get

$$\mathrm{C}_t = \frac{\left[\left[\frac{\mathrm{R} - D}{U - D}\right]\mathrm{C}_u + \left[\frac{U - \mathrm{R}}{U - D}\right]\mathrm{C}_d\right]}{R},$$

that is, the call value equals the present value of the future payoffs from the call.

$$C_t = \frac{[(P_u C_u) + (P_d C_d)]}{R},$$

where

$$P_u = \frac{(R - D)}{(U - D)} \text{ and}$$

$$P_d = \frac{(U - R)}{(U - D)}.$$

Inserting values we get $P_u = 0.8, P_d = 0.2$.

14.6 The Multiperiod Binomial Model

In the previous example, we assumed that the world lasts one period. Let us extend the model to two periods. The stock can go up or down at time = 0 (i.e., now) and at the end of $t = 1$. The stock price movement is shown in Exhibit 14.10.

The stock price starts at S and either rises to S_u or falls to S_d in one period. At the end of one period, the stock can again rise or fall. So there are four outcomes as shown in the exhibit.

The value of call option can be C_u, C_d, C_{uu}, or C_{dd} depending on how the stock price evolves. This is shown in Exhibit 14.11.

The call value, again, equals the expected value of the payoffs at expiration discounted to the present

$$C_t = \frac{P_{uu}C_{uu} + P_{ud}C_{ud} + P_{du}C_{du} + P_{dd}C_{dd}}{R^2}.$$

Going back to the previous example, the \$100 stock can rise or fall by 10%, $P_u = 0.8$ and $P_d = 0.2$. Further, the probability of increase in one period is independent of the probability of an increase in any other period.

Exhibit 14.10 Two-period pay-offs

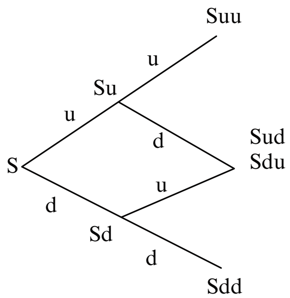
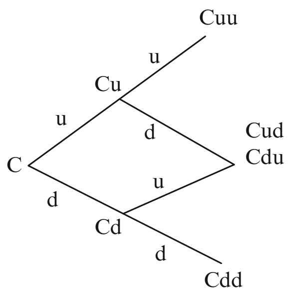


Exhibit 14.11 Two-period call option pay-off



$S_u = 110; S_d = 90; S_{uu} = 121; S_{dd} = 81; S_{ud} = S_{du} = 99; P_{uu} = 0.8 \times 0.8 = 0.64;$
$P_{ud} = 0.8 \times 0.2 = 0.16; P_{du} = 0.16;$ and $P_{dd} = 0.2 \times 0.2 = 0.04$

Having found the value of stock price at the end of the nodes, we are able to calculate the option value by means of backward induction – that is, working from the far right of the lattice, back to the origin.

The call price at expiration equals the terminal stock price minus the exercise price of 100 or 0, whichever is higher. The call option expires in the money only if the stock price goes up in both the periods.

That is,

$$C_{uu} = \$21, C_{dd} = 0, C_{du} = C_{ud} = 0.$$

The value of call option at initiation,

$$C = \frac{0.64(21) + 0.16(0) + 0.16(0) + 0.04(0)}{1.062},$$
$$C = \$11.96.$$

The binomial method has some limitations.

- The model is computationally difficult as the number of periods increases
- Increasing the number of periods while at the same time keeping the time to expiration constant requires reestimation of U, D, and r
- We have used arbitrary values for U and D

Modeling stock returns by a log normal process solves these problems.

The binomial method pioneered by Cox et al. (1979) is a common method to price all types of options due to its flexibility. The method essentially models the movement of the stock price and, hence, the option price over time by considering the movements of the asset at each time node. The asset is assumed to only be allowed to take either an "up" step or a "down" step, where these steps are given as

$$u = e^{\sigma\sqrt{T-t}} \text{ for an up movement and}$$
$$d = 1/u \text{ for a down movement.}$$

We then need to assign a probability of the asset moving higher (i.e., increasing) as

$$P_u = \frac{e^{r(T-t)} - d}{(u-d)}$$

and for the probability of a down movement, the combined probabilities must be equal to 1; hence, the probability of the down movement is simply $(1 - p)$.

14.7 The Black–Scholes Model for Pricing Call Options

In the 1970s Fischer Black and Myron Scholes came up with a closed-form solution for the pricing of European-type options that allows us to price various derivatives, including options on commodities, financial assets, and even pricing of employee stock options. Obviously, the one-period binomial option pricing model looks unrealistic because it considers only two states of the world. If the time period between two stock price movements is a minute or a second, the characterization is not that unrealistic. The Black–Scholes model assumes a more general diffusion process (of stock prices).

The Black–Scholes option-pricing model uses the five variables (for nondividend paying stocks) viz. X, S, T, r, and σ to give a dollar value for the European call option where X = exercise price, S = stock price, T = time for expiration, r = risk-free rate of return, and σ = standard deviation of stock prices.

According to the model, the value of call option $= SN(d_1) - X\mathrm{e}^{-rt}N(d_2)$, where

$$d_1 = \frac{\ln(S/X) + (r + \sigma^2/2)\,t}{\sigma\sqrt{t}},$$

$$d_2 = d_1 - \sigma\sqrt{t}.$$

$X\mathrm{e}^{-rt}$ is the present value of the exercise price in the continuous form: d_1 and d_2 are calculated and the cumulative normal distribution functions, $N(d_1)$ and $N(d_2)$ corresponding to the standardized normal variables are estimated.

Although the model "looks complex" it can be explained in a more intuitive way. The value of call option is the maximum of 0 and the difference between S and X. The formula is essentially the difference between S and present value of X. Since S is not constant we multiply by a "risk factor" $N(d_1)$. Likewise, we multiply the present value of X by a "risk factor" (d_2).

Consider the following example:

$S = \$100$, $r = 6\%$, $X = \$100$, $T - t = 12$ months, S.D. $= 0.10$ p.a.

Substituting these values into the equation

$$d_1 = 0.65,\ d_2 = 0.55.$$

The cumulative normal values associated with d_1 and d_2 are the probability that normally distributed variable with a zero mean and a standard deviation of 1.0 will have a value equal to or less than d_1 and d_2.

Consulting the table on cumulative distribution function for the standard normal random value we get,

$$N(d_1) = 0.7422,$$
$$N(d_2) = 0.7088.$$

Substituting in the Black–Scholes formula we get

$$C_t = 7.46.$$

Similarly, the value of a put option, according to the model is

$$P_t = X\,\mathrm{e}^{-r(T-t)}N(-d_2) - S_t N(d_1).$$

14.8 The Assumptions Underlying the Model

The Black–Scholes Model is based on certain assumptions.

- There are no transaction costs or taxes
- No dividends are paid out on the underlying stock during the option life
- The option can only be exercised at expiry (i.e., European-type option)
- Borrowing and lending at risk-free interest rate are unrestricted
- There are no restrictions on short sales
- Stock returns follow a lognormal distribution or logarithmic of stock returns follow a normal distribution
- Interest rates do not change over the life of the option (and are known)

Clearly some of these assumptions are not realistic because most stocks pay dividends; most exchange traded contracts are American type and interest rates/ volatility do not remain constant. Much of the academic work on option pricing has addressed these issues (Black 1989).

14.9 Using Option Pricing Calculators

Standard Microsoft Excel-based option pricing calculators are available for traders and investors.[4] These spreadsheets use inputs for option pricing variables like S, X, r, T, and σ to calculate the Black–Scholes value of call option or put option. Assume the following data:

Stock price	\$80.00
Strike price	\$80.00
Volatility	20.00%
Days to expiration	60
Interest rate	6.00%
Option type	Call

[4] See, for example, http://www.hoadley.net/options.

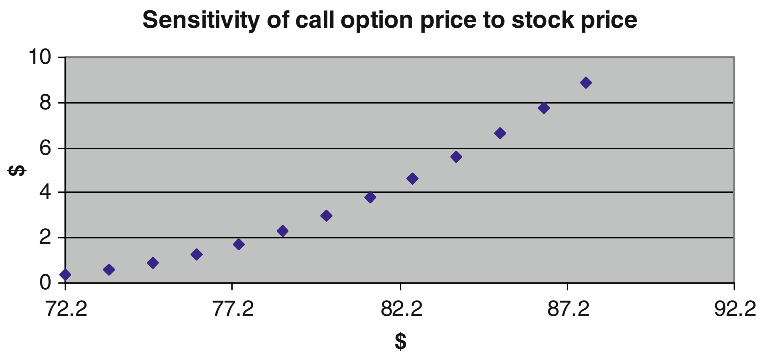
The spreadsheet calculates the values of call and put options for these parameters. The output is shown below.

Sensitivities	Call	Put
Call option value	$2.986	
Put option value	2.201	
Delta	0.564	−0.436
Gamma	0.061	0.061
Theta	−0.028	−0.015
Vega	0.128	0.128
Rho	0.07	−0.06

One may change the values of input variables (like volatility) to recalculate the option value. The sensitivity of call option price to changes in stock price is presented in Exhibit 14.12.[5]

Exhibit 14.12 Sensitivity of call option price to stock price

Stock price	Call option price
72.22	0.388
73.51	0.597
74.81	0.883
76.11	1.258
77.41	1.730
78.7	2.306
80.0	2.986
81.3	3.769
82.59	4.646
83.89	5.610
85.19	6.647
86.49	7.748
87.78	8.9



[5] Option sensitivities and option "greeks" are discussed later.

These spreadsheets have provisions to price options using the binomial method as well. The Hoadley option pricing spreadsheet has been used to draw a binomial tree shown in Exhibit 14.13 for the following data given below.

Strike price	$29.00
Underlying stock price	$30.00
Days to expiration	40
Dividend	0.0
Type of option	Call
Volatility	30.00%
Interest rate	5.00%
No. of tree steps	6
Exercise Style	European

The stock price and the call option price at each node are presented in Exhibit 14.13. The stock price at expiration would be $38.262 if the stock price rose in each period. The corresponding call option price is $9.262. The spreadsheet uses inputs shown above to draw a binomial tree in a few seconds, which would otherwise take much longer.

The same data has been used to draw a tree for a European put in Exhibit 14.14. The put price is $0.717.

Exhibit 14.13 Binomial tree for a European call on a non dividend paying stock

Call Value = $1.875						
						38.262/9.262
					36.742/7.768	
				35.282/6.335		35.282/6.282
			33.88/4.96		33.88/4.907	
		32.534/3.722		32.534/3.587		32.534/3.534
	31.241/2.687		31.241/2.486		31.241/2.268	
30.00/1.875		30.00/1.653		30.00/1.385		30.00/1.00
	28.808/1.063		28.808/0.818		28.808/0.501	
		27.663/0.472		27.663/0.251		27.663/0.00
			26.564/0.126		26.564/0.00	
				25.509/0.00		25.509/0.00
					24.495/0.00	
						23.522/0.00
Days Remaining						
0	6.67	13.33	20	26.67	33.33	40

Exhibit 14.14 Binomial tree for a European put on a non dividend paying stock

						38.262/0.00
					36.742/0.00	
				35.282/0.00		35.282/0.00
			33.88/0.00		33.88/0.00	
		32.534/0.082		32.534/0.00		32.534/0.00
	31.241/0.314		31.241/0.165		31.241/0.00	
30.00/0.717		30.00/0.547		30.00/0.332		30.00/0.00
	28.808/1.123		28.808/0.931		28.808/0.666	
		27.663/1.703		27.663/1.534		27.663/1.337
			26.564/2.482		26.564/2.409	
				25.509/3.438		25.509/3.491
					24.495/4.478	
						23.522/5.478

14.10 Dividend Payments and Option Prices

The Black–Scholes formula for European-type options does not incorporate dividend payments. Dividends can be thought of repayment of a portion of the share's value, that is, leakage of value. The stock becomes less valuable to the extent of dividend paid. So the formula needs to be adjusted for dividends when the underlying stock pays dividends.

Adjustment for dividend can take on two forms.

14.10.1 Adjustments for Known Dividend

Some stocks have predictable dividend payment pattern. For such stocks,

- forecast dividends on the basis of dividend growth (from the current level) and
- deduct the present value of dividend to be paid during the life of the option from the stock price and then apply the Black–Scholes formula.

Consider the following example:

$X = 100$,
$T = 150\,\text{days}$,
$S = 102$,
Dividend $=$ \$3 in 90 days,
$r = 9\%$,
S.D. $= 0.30$,
The present value of dividend $= \$3\,\mathrm{e}^{-\mathrm{r}(90/365)} = \$2.93$.

Subtract this present value from the stock price of \$100 and use the adjusted stock price in the formula.

14.10.2 Adjustment for Continuous Dividends: Merton's Constant Dividend Yield Model

The Merton's Constant dividend yield model assumes that the leakage of value in the form of dividends is continuous, rather than discrete. In other words, dividend payments accrue to the shareholder even though actual payments are made at discrete intervals. The modified version of Black–Scholes incorporating continuous dividend payments is given below (See Merton 1973b):

$$C_t = \mathrm{e}^{-\delta(T-t)} S_t N(d_1) - X\,\mathrm{e}^{-r(T-t)} N(d_2),$$
$$\ln\left(\frac{S}{X}\right) + (r - \delta + 0.5\sigma^2)(T-t),$$
$$d_2 = d_1 - \sigma\sqrt{T} - t,$$

where $S =$ stock price, $X =$ strike price, $T =$ expiration term (years), $d =$ annualized dividend yield, $\sigma =$ annual stock price volatility, $r =$ risk-free interest rate, $\delta =$ dividend rate, and $N() =$ cumulative normal distribution function.

The annualized yield on treasury security maturing on the option's expiry date is taken as the risk-free rate. Dividend yields are measured as the annualized yield over the past 1, 2, or 3 years.

14.11 Binomial Model and Dividend Payments

The binomial lattice demonstrated earlier is for stocks that do not pay dividends. The lattice needs to be adjusted to reflect the impact of dividends on the stock price.

Adjustments can be made for three situations.

1. Dividends are continuous
2. Dividend yield (at a certain time) is known
3. Dollar dividend (at a certain time) is known

14.11.1 Continuous Dividends

To draw the binomial lattice we need U, D, and P_u. The formulae, after adjusting for continuous dividend payments are

$$U = e^{\sigma/\Delta t},$$
$$D = \frac{1}{U},$$
$$P_u = \frac{e^{(r-\delta)\Delta t} - D}{(U - D)}.$$

14.11.2 Known Dividend Yield

Consider the following example:

$$S = 80,$$
$$X \text{ (for call and put)} = 75,$$
$$\text{S.D.} = 0.3,$$
$$r = 7\%,$$
$$w \text{ (dividend yield)} = 0.03 \text{ (i.e., } 3\%),$$
$$T = 120\,\text{days},$$
$$\text{Therefore,} \Delta t = \frac{40}{365} = 0.1096,$$
$$U = e^{0.3\sqrt{0.1096}} = 1.1044,$$
$$D = \frac{1}{1.1044} = 0.9055$$
$$P_u = \frac{(1.0077 - 0.9055)}{(1.1044 - 0.9055)} = 0.5138, \quad P_d = 1 - 0.5138 = 0.4862$$

Discounting factor for one period $= e^{0.07(40/365)} = 0.9924$.

Use this discount rate to discount expected stock price at each node and work backwards to arrive at stock price and option price at time $t = 0$.

14.11.3 Known Dollar Dividends

When *dollar* dividends are known,

- Calculate the present value of all dividends to be paid during the life of the option as of time $= t$
- Subtract this present value from the current stock price to form adjusted stock price
- Create the binomial tree

- After generating the tree, add to the stock price at each node the PV of future dividends to be paid during the life of the option
- Compute the options values in the usual way by working through the binomial tree

Essentially, this method adjusts the stock price and the exercise price for dividend payment. The payment of dividend reduces the cost of exercise.

Exhibit 14.15 presents the stock price/*call option* lattice for the data given below. The call price turns out to be $0.606.

Strike price	$29.00
Underlying stock price	$ 30.00
Volatility	30.00%
Interest rate	5.00%
No. of tree steps	6
Exercise style	European
Dividend	2.5%
Days to exdividend	25
T	40 days

Exhibit 14.16 presents the stock price/*put option* lattice for the same data. The put price turns out to be $1.939.

Exhibit 14.15 European Call on a dividend paying stock

						35.085/6.085
					33.691/4.717	
						32.352/3.352
					31.066/2.093	
						29.832/0.832
					28.647/0.417	
	30.00/0.606					27.509/0.00
					26.416/0.0	
						25.366/0.00
					24.358/0.0	
						23.39/0.00
					22.461/0.0	
						21.568/0.00
Days from time now						
	0	6.67	13.33	20	26.67	40
Call price = $0.606						

Exhibit 14.16 European put on a dividend paying stock

						35.085/0.00
					33.691/0.0	
						32.352/0.00
					31.066/0.00	
						29.832/0.00
					28.647/0.743	
	30.00/1.939					27.509/1.491
					26.416/2.558	
						25.366/3.634
					24.358/4.615	
						23.39/5.61
					22.461/6.513	
						21.568/7.432
Days from time now						
	0	6.67	13.33	20	26.67	40

14.12 Exercise Style and Options Prices

The original Black–Scholes formula considers European-type options. But most exchange traded options contracts are American type, which means that the formula needs to be adjusted. For nondividend paying stocks early exercise is never optimal. But for dividend paying stocks, it might be optimal to exercise the option if the situation warrants. It is possible to price options when the stock pays a single dividend or a series of known dividends during the life of the option.

Since American options can be exercised any time up till maturity, the holder evaluates the position every time the stock pays dividends. That is, the trader can either exercise and collect stock (and dividend) or wait. The trader would want to wait if it has additional value. In other words, the American option holder essentially has a series of European options with maturity dates coinciding with each dividend payment date and the final maturity date. A rational trader would exercise the option on that day which gives the highest payoff. The highest value is taken as the value of the call option. A number of approaches for pricing American options are available.[6] There is no close form solution for a call option on a dividend paying stock. We will not describe these models here as they are beyond the scope of the book.

The binomial approach can be applied to American-type calls and puts on stocks with all kinds of dividend payments. The values of American and European call on nondividend paying stock are same. But values of puts are not the same.

[6] A list of important papers and books are presented at the chapter. In particular, see Roll (1977), Black (1975), and Whaley (1981).

The option value is set equal to the maximum of:

1. The expected option value in one period discounted for one period at the risk-free rate (at each node)
2. The immediate exercise value of the option, *S–X* for a call or *X–S* for a put

The lattices will be the same at most points except where the early exercise value is more than the value of expected option value. At expiration, both American- and European-type options have the same value. Starting from the expiration, work backwards and examine the two values at each node.

Consider the following example:

Stock price	29.00
Stock price	30.00
Days to expiration	40
Dividend (% yield or $)	2.50
Volatility (%)	30.0
Interest rate (%)	5.00
Option type	Call
Exercise style	American
No. of tree steps	6

The binomial lattice is shown in Exhibit 14.17.[7] The price of the call option is $1.4159.

Exhibit 14.18 presents the binomial lattice for an American-type put option on the same stock.

14.13 Convergence of Binomial and Black–Scholes Model

Both the binomial model and the Black–Scholes model find application in pricing options. The prices according to the two models converge when the number of steps in the binomial lattice is increased. Consider the following data:

Stock price	$100
Strike price	$96.00
Days to expiration	40
Volatility	30%
Interest rate	5%
Option type	Call

The Black–Scholes Price turns out to be $2.3859. The binomial model was applied to the same data. The results of the application are reproduced below.

[7] The first value is the stock price; the second value is the option price; and those in boldface are the amended prices from early exercise.

Exhibit 14.17 American call on a dividend paying stock

						35.085/6.085
					33.691/4.717	
				32.352/3.405		32.352/3.352
			33.565/4.565		31.066/2.093	
		32.328/3.355		29.832/1.256		29.832/0.832
	31.141/2.241		**31.145/2.145**		28.647/0.417	
30.00/1.416		30.005/1.126		27.509/0.209		27.509/0.00
	28.909/0.590		28.914/0.014		26.416/0.00	
		27.862/0.052		25.366/0.00		25.366/0.00
			26.856/0.00		24.358/0.00	
				23.39/0.00		23.39/0.00
					22.461/0.00	
						21.568/0.00
Days Remaining						
0	6.67	13.33	20	26.67	33.33	40

Exhibit 14.18 American put on a dividend paying stock

			35.085/0.00
			32.352/0.00
			29.832/0.00
30.00/1.96			27.509/1.491
		26.416/2.584	
	25.366/3.634		25.366/3.634
		24.358/4.642	
	23.39/5.61		23.390/5.610
		22.461/6.539	
			21.568/7.432
Put price = \$1.96			

Range of steps considered: 10–150.
For steps in the range

Maximum binomial price	2.3915
Average Binomial Price	**2.3856**
Minimum Binomial Price	2.3796

As can be seen, the call option price according to binomial model converges to that of Black–Scholes in less than 150 steps.

14.14 Inputs for the Black–Scholes Model

To apply the Black–Scholes model, we need inputs for all the variables that enter the formula. The stock price is observable; term to maturity and exercise price are fixed by the exchange. But we need to calculate the risk-free rate and volatility.

14.14.1 Estimating Risk-Free Rate

The Treasury bill rate is usually used as a proxy for risk-free rate. But quoted T bill rates cannot be used directly because interest rates are to be presented in a continuously compounded format to be consistent with the Black–Scholes framework. Further, the tenor of the interest rate and that of the option need to coincide.

T bill rates are quoted as discount rates. So they have to be converted and expressed as continuously compounded rates. The bill that matures closest to option expiration is used for the purpose.

Assume the following data:

$$\text{Days to maturity} = 90$$
$$\text{Average (of bid and ask) yield on the } T \text{ bill} = 8.8\%$$

The price is estimated as a percent of its face value using the formula

$$P = 1 - 0.01\,(\text{Average yield}) \times \left(\frac{\text{Days until maturity}}{360}\right)$$
$$P = 1 - 0.01\,(8.8) \times \left(\frac{90}{360}\right)$$
$$P = 0.978 \text{ or } 97.8\% \text{ of its face value.}$$

The continuously compounded rate is estimated using the relationship

$$\mathrm{e}^{r(T-t)} = \frac{1}{P}$$
$$\mathrm{e}^{r(0.25)} = \frac{1}{0.978}$$
$$\text{or } 0.25\,r = \ln(1.2820)$$
$$r = \frac{\ln(1.2820)}{0.25}$$

14.14.2 Estimating the Stock's Standard Deviation

The second input is the stock's standard deviation, which is more difficult to estimate. The volatility of stock prices can be estimated in two ways.

14.14.2.1 Using Historical Data

The standard deviation of the stock's historical returns can be used as a proxy for volatility in future. One may use recent stock price history to estimate the standard deviation as follows:

- Gather stock price data for some recent time period (say, for 30 days)
- Compute price relatives as $\mathrm{PR} = (\mathrm{P}_t/\mathrm{P}_{t-1})$
- Calculate the log of price relatives
- Calculate the mean and S.D. of price relatives
- This would give us daily volatility

- Annualize the volatility assuming, say, 250 trading days
- Annualized S.D. = Daily S.D. × $\sqrt{250}$[8]

14.14.2.2 Implied Volatility

The second approach is to extract the volatility of the stock from the option price itself. The Black–Scholes formula uses inputs for S, X, t, σ, and r to calculate the value of a call or put option. Given the prevailing option price, S, X, r, and t, one can solve for the value of σ by trial and error. Usually, volatility estimates are made from at-the-money options because out of the money and in-the-money options give spurious estimates.

14.15 Option Sensitivities

The option value is sensitive to the values of input variables like the stock price, volatility, time to maturity, and interest rates.

Option *Greeks* measure the sensitivity of the option to its parameters.

Delta measures rate of change of the option's value with respect to the stock price; it is the first differential of option price with respect to the price of the underlying asset. Delta also changes gradually over time even if there is no price movement of the underlying asset. The change in delta for a given change in the asset price is known as Gamma.

Gamma is the second derivative of the option value with respect to the price of the underlying asset. Variation in Delta requires that a hedged position be rebalanced if it is to remain delta neutral after the price of the underlying asset has changed. How much adjustment is needed, depends on how much the Delta changes, that is, on Gamma.

Theta refers to the rate of time decay for an option. It is the first differential of the option value with respect to time. Holding all other things constant, an option loses value as it approaching to the expiration day. Theta measures the cost of holding an option long, and the reward for writing it.

Vega measures the relationship between the volatility of the underlying asset and the option value. It is the first differential of the option price with respect to the volatility (S.D.). The more volatility the underlying asset is, the more valuable the option becomes, since the chance for the option to be deep-in-the-money is greater.

Rho measures the sensitivity of the option value to the interest rate. It is the derivative of the option value with respect to the interest rate. The higher the interest rate, the greater the time value of the option. Hence, Rho is positive for calls and negative for puts. For both, calls and puts, the longer the time to expiration, the larger is the effect of the interest rate on the option value.

[8] Volatility increases as square root of time.

Exhibit 14.19 Values of Greeks

	Call option	Put option
Price	$7.202	$0.741
Delta	0.823	−0.177
Gamma	0.035	0.035
Vega	0.13	0.13
Theta	−0.023	−0.008
Rho	0.188	−0.046

Given below are the formulae for the Greeks.

$$\text{Delta (call)} = \frac{\partial C}{\partial S} = N(d_1)$$
$$\text{Gamma (call)} = \frac{\partial\,\text{Delta}}{\partial S} = N'(d_1)/S\sigma\sqrt{T}$$
$$\text{Vega (call)} = \frac{\partial C}{\partial \sigma} = S\sqrt{T}N'(d_1)$$
$$\text{Theta (call)} = \frac{\partial C}{\partial T} = -[\mathrm{S}_t N'(d_1)\sigma/2\sqrt{t}] - r\mathrm{X}\mathrm{e}^{-r\sqrt{t}}N(d_2)$$
$$\text{Rho (call)} = \frac{\partial C}{\partial r} = \mathrm{XTe}^{-r\sqrt{t}}N(d_2)$$

Similarly, the Greeks of put option can be derived.

Consider the following example:

$$S = \$100$$
$$X = \$95.00$$
$$T = 0.25\,\text{year}$$
$$R = 0.06$$
$$\text{S.D.} = 0.15$$

Exhibit 14.19 presents the values of Greeks for the above set of inputs.

14.16 Concluding Comments

The pricing of options is an important breakthrough in modern finance theory. In this chapter, we introduced the usage of option pricing tables and calculators to estimate the value of plain vanilla American- and European-type call and put options on nondividend paying as well as dividend paying stocks. In the next chapter, we introduce some of the exotic options and their pricing. The subsequent chapter examines the empirical evidence on options.

Appendix: Features of Exchange-Traded Options Contracts

Option contracts are available on stocks, indexes, exchange-traded funds, interest rates, currency, etc. Option contracts trade both on major exchanges like the Chicago Board Options Exchange (e.g., equity options) and in over-the-counter market (e.g., foreign currency option). The exchange specifies the strike price, maturity dates, exercise style, margin (if any), and the settlement procedure. The specifications of Equity Option Contract and Long-Term Equity Anticipation Securities (LEAPS) traded on the Chicago Board Options Exchange are given below.

A. Equity Options Product Specifications[9]

Underlying

Generally, 100 shares of common stock or American Depository Receipts ("ADRs") of companies that are listed on securities exchanges or trades over-the-counter.

Strike Price Intervals

Generally, 2.5 points when the strike price is between $5 and $25, 5 points when the strike price is between $25 and $200, and 10 points when the strike price is over $200. Strikes are adjusted for splits, recapitalizations, etc.

Strike (Exercise) Prices

In-, at-, and out-of-the-money strike prices are initially listed. New series are generally added when the underlying trades through the highest or lowest strike price available.

Premium Quotation

Stated in points and fractions. One point equals $100. Minimum tick for options trading below 3 is .05 and for all other series is .10.

Expiration Date

Saturday immediately following the third Friday of the expiration month.

[9] This section is based on the information provided on the Chicago Board Options Exchange Website http://www.cboe.com.

Expiration Months

Two near-term months plus two additional months from the January, February, or March quarterly cycles.

Exercise Style

American–Equity options generally may be exercised on any business day before the expiration date.

Settlement of Option Exercise

Exercise notices properly tendered on any business day will result in delivery of the underlying stock on the third business day following exercise.

Position and Exercise Limits

Limits vary according to the number of outstanding shares and past 6-month trading volume of the underlying stock. The largest in capitalization and most frequently traded stocks have an option position limit of 250,000 contracts (with adjustments for splits, recapitalizations, etc.) on the same side of the market; smaller capitalization stocks have position limits of 200,000, 75,000, 50,000, or 25,000 contracts (with adjustments for splits, recapitalizations, etc.) on the same side of the market. The number of contracts on the same side of the market that may be exercised within any five consecutive business days is equal to the position limit. Equity option positions must be aggregated with equity LEAPS positions on the same underlying for position and exercise limit purposes. Exemptions may be available for certain qualified hedging strategies.

Margin

Purchases of puts or calls with 9 months or less until expiration must be paid for in full. Writers of uncovered puts or calls must deposit/maintain 100% of the option proceeds* plus 20% of the aggregate contract value (current equity price $\times$ \$100) minus the amount by which the option is out-of-the-money, if any, subject to a minimum for calls of option proceeds* plus 10% of the aggregate contract value and a minimum for puts of option proceeds* plus 10% of the aggregate exercise price amount. (*For calculating maintenance margin, use option current market value instead of option proceeds.) Additional margin may be required pursuant to Exchange Rule 12.10.

Last Trading Day

Trading in equity options will ordinarily cease on the business day (usually a Friday) preceding the expiration date.

Trading Hours

8:30 a.m.–3:00 p.m. Central Time (Chicago time).

B. Long-Term Equity Anticipation Securities

LEAPS are long-term options available on $\sim$450 equities and 10 indexes. LEAPS provide investors with a longer-term view of the market as a whole or on an individual stock. As with traditional short-term options, LEAPS are available in two types, calls and puts.

Equity LEAPS Product Specifications

Symbol

Normally, symbols for all equity LEAPS expiring in any calendar year are based on the underlying stock symbol, but are modified by either the letter L, V, W, or Z. For example, LEAPS on XYZ might use the symbol "LXY" and LEAPS on PQR might use "LQR"; similarly, LEAPS on XYZ expiring in the next year might use the symbol "WXY," while those expiring in the year following that might use "VYZ." Because of conflicts with preexisting security symbols, it is not possible to consistently alter the underlying stock symbol in the same manner for every LEAP expiring in a certain year, nor for each LEAP expiration on a specific underlying stock.

Underlying

Generally, 100 shares of common stock or "ADRs" of companies that are listed on securities exchanges or trade over-the-counter.

Product Description

Equity LEAPS are long-dated options on common stock or ADRs of companies that are listed on securities exchanges or trade over-the-counter. Equity LEAPS expire in $\sim$2–3 years from the date of initial listing; equity LEAPS roll into the standard option after the May, June, or July expiration depending upon whether the standard option associated with the LEAPS is on the January, February, or March expiration cycle.

Strike Price Intervals

2.5 points when the strike price is between $5 and $25, 5 points when the strike price is between $25 and $200, and 10 points when the strike price is over $200. Strikes are adjusted for splits, recapitalizations, etc.

Strike (Exercise) Prices

In-, at-, and out-of-the-money strike prices are initially listed. New series are generally added once a year and after substantial market moves.

Premium Quotation

Stated in points and fractions; one point equals $100. Minimum tick for series trading below 3 is .05 and for all other series is .10.

Expiration Date

Saturday immediately following the third Friday of the expiration month.

Expiration Months

May be up to 39 months from the date of initial listing, January expiration only.

Exercise Style

American–Equity LEAPS generally may be exercised on any business day before the expiration date.

Settlement of Option Exercise

Exercise notices properly tendered on any business day will result in delivery of the underlying stock on the third business day following exercise.

Position and Exercise Limits

Limits vary according to the number of outstanding shares and past 6-month trading volume of the underlying security. The largest in capitalization and most frequently traded stocks have an option position limit of 75,000 contracts (with adjustments for splits, recapitalizations, etc.) on the same side of the market; smaller capitalization stocks have position limits of 60,000, 31,500, 22,500, or 13,500 contracts (with adjustments for splits, recapitalizations, etc.) on the same side of the market. The number of contracts on the same side of the market that may be exercised within any five consecutive business days is equal to the position limit. Equity option positions must be aggregated with equity LEAPS positions on the same underlying for position and exercise limit purposes. Exemptions may be available for certain qualified hedging strategies.

Margin

For purchases of puts or calls with more than 9 months until expiration, deposit/maintain 75% of the total cost/option current market value. When time to expiration reaches 9 months, the option no longer has value for margin purposes. Purchases of puts or calls with 9 months or less until expiration must be paid for in full.

Writers of uncovered puts or calls must deposit/maintain 100% of the option proceeds* plus 20% of the aggregate contract value (current equity price $\times$\$100) minus the amount by which the option is out-of-the-money, if any, subject to a minimum for calls of option proceeds* plus 10% of the aggregate contract value and a minimum for puts of option proceeds* plus 10% of the aggregate exercise price amount. (*For calculating maintenance margin, use option current market value instead of total cost or option proceeds.) Additional margin may be required pursuant to Exchange Rule 12.10.

Last Trading Day

Trading in equity LEAPS (after the rollover to the standard option on the underlying) will ordinarily cease on the business day (usually a Friday) preceding the expiration date.

Trading Hours

8:30 a.m.–3:00 p.m. Central Time (Chicago time).

Exhibit A.1 Options price quotation for Infosys technologies (end of day quotes on National Stock Exchange as on 19 February 2008)

Stock Price = INR 1565.30									
Expiry Date	Strike Price (Rs)	Put/Call	Open (Rs)	High (Rs)	Low (Rs)	Close (Rs)	Volume	Value (Rs m)	Open Interest
Feb 28	1,710	CA	6.00	7.50	5.80	6.10	10	1.72	28,600
Feb 28	1,530	CA	70.00	70.00	42.20	43.00	6	0.95	5,600
Feb 28	1,800	CA	3.00	3.00	3.00	3.00	6	1.08	25,500
Feb 28	1,650	CA	14.10	14.85	10.10	12.60	22	3.66	25,500
Feb 28	1,500	CA	86.00	94.00	71.05	82.00	12	1.90	13,300
Feb 28	1,470	CA	90.00	90.00	90.00	90.00	1	0.16	1,000
Feb 28	1,590	CA	23.00	34.95	22.05	27.30	44	7.12	26,600
Feb 28	1,620	CA	20.00	23.50	16.00	19.50	42	6.89	43,100
Feb 28	1,560	CA	38.00	50.00	32.00	41.55	80	12.82	23,100
Feb 28	1,500	PA	18.00	26.80	16.50	21.00	29	4.41	15,900
Feb 28	1,530	PA	30.00	30.00	30.00	30.00	1	0.16	1,400
Feb 28	1,590	PA	70.00	70.00	70.00	70.00	1	0.17	2,600
Feb 28	1,470	PA	12.00	18.00	12.00	18.00	2	0.30	4,000
Feb 28	1,620	PA	67.00	85.00	67.00	85.00	2	0.34	700
Feb 28	1,560	PA	50.00	52.20	31.80	39.70	24	3.85	4,200

Source: Equity Master

Exhibit A.2 Options price quotation for Reliance (end of day quotes on National Stock Exchange as on 19 February 2008)

Stock price = INR 2481									
Expiry Date	Strike Price (Rs)	Put/Call	Open (Rs)	High (Rs)	Low (Rs)	Close (Rs)	Volume	Value (Rs m)	Open Interest
Feb 28	2,250	PA	18.00	18.00	18.00	18.00	1	0.17	1,875
Feb 28	2,280	CA	280.00	280.00	280.00	280.00	1	0.19	750
Feb 28	2,280	PA	8.00	10.00	8.00	9.25	8	1.37	17,775
Feb 28	2,310	CA	289.00	289.00	262.05	262.05	11	2.13	33,825
Feb 28	2,310	PA	11.25	11.90	7.10	11.55	40	6.96	34,125
Feb 28	2,400	CA	209.00	230.00	162.55	171.50	1,105	216.13	96,825
Feb 28	2,400	PA	15.10	24.00	12.50	21.60	1,659	300.57	279,375
Feb 28	2,450	CA	120.10	120.10	120.10	120.10	1	0.19	750
Feb 28	2,500	CA	114.00	147.90	94.00	103.15	484	95.45	111,000
Feb 28	2,500	PA	39.00	60.00	27.55	53.45	676	128.78	74,775
Feb 28	2,550	CA	90.00	109.90	66.00	68.25	81	16.05	16,125
Feb 28	2,550	PA	50.00	65.00	38.00	65.00	34	6.62	1,875
Feb 28	2,600	CA	73.20	84.00	46.60	50.85	2,160	432.15	260,400
Feb 28	2,600	PA	88.00	110.00	64.00	103.15	340	68.30	27,525
Feb 28	2,650	CA	52.20	57.80	32.00	35.70	182	36.83	21,300
Feb 28	2,700	CA	32.45	34.95	19.50	20.75	1,220	249.66	341,925
Feb 28	2,700	PA	149.00	168.00	117.00	168.00	8	1.70	1,200
Feb 28	2,750	CA	18.50	20.00	15.00	15.50	33	6.85	14,250
Feb 28	2,800	CA	12.00	15.45	7.00	9.10	304	64.12	125,325
Feb 28	2,900	CA	10.00	10.00	5.00	5.00	17	3.71	47,100
Feb 28	3,000	CA	5.05	5.65	4.00	5.35	20	4.51	126,300
Feb 28	3,100	CA	1.40	1.40	1.40	1.40	2	0.47	63,525
Mar 27	2,500	PA	105.00	105.00	105.00	105.00	1	0.20	150
Mar 27	2,600	CA	160.00	160.00	135.00	135.00	3	0.62	225
Apr 24	2,600	CA	589.80	589.80	589.80	589.80	1	0.24	150

14.17 End of the Chapter Exercises

1. Refer to the call and put option prices on the Infosys technologies, a world leader in IT consulting, quoted in Exhibit A.1 on page 352. Is the February 28, Rs. 1,710 call option fairly priced? Why does the option have value despite the fact that the exercise price of the option is more than the prevailing stock price? Use the option pricing table.
2. Estimate the intrinsic value of the Rs. 1,530 strike call option on Infosys. Repeat analysis for Rs. 1,470 *put* option. Use the Black–Scholes formula. Refer to other data given below.

   Risk-free rate (1 year) $= 7.51\%$
   Dividend yield $= 0.80\%$
   Daily S.D. $= 2.34\%$ or 36.99% p.a.
   Three-month volatility (S.D.) of Infosys stock returns $= 5.28\%$
   One-month volatility $= 5.11\%$

3. Refer to the Rs. 2,280 call option and put option price quotes for Reliance Industries, a large conglomerate in Asia, stock given in Exhibit A.2 on page 353. Do these prices conform to the put–call parity relationship?

References

Amin K (1993) Jump diffusion option valuation in discrete time. J Finance 48:1833–1863
Barone A, Whaley R (June 1987) Efficient analytic approximation of American option values. J Finance 42:301–320
Bjerksund P, Stensland G (1993) Closed-form approximation of american options. Scandinavian J Manage 9:87–99
Black F (July/August 1975) Fact and fantasy in the use of options. Financial Analysts Journal 31, pp 36–41, 61–72
Black F (1989) How to use the holes in Black–Scholes. J Appl Corporate Finance 1:67–73
Black F, Scholes M (1973) The pricing of options and corporate liabilities. J Political Econ
Boyle P (1986) Option valuation using a three-jump process. Int Options J 3:7–12
Breen R (1991) The accelerated binomial option pricing model. J Financ Quant Anal 26(2): 153–164
Brennan M, Schwartz E (1978) Finite difference methods and jump processes arising in the pricing of contingent claims. J Finance Quant Anal 13:462–474
Broadie M, Detemple J (1996) American option valuation: new bounds, approximations, and a comparison of existing methods. Rev Financ Studies 9(4):1211–1250
Bunch D, Johnson HE (1992) A simple and numerically efficient valuation method for American puts, using a modified Geske-Johnson approach. J Finance, 47(2):809–816
Caporale G, Cerrato M (2005) Valuing american put options using chebyshev polynomial approximation. Centre for International Capital Markets, Discussion Paper No. 05–03
Carr P, Faguet D (1996) Fast accurate valuation of american options. Working Paper, Cornell University
Carr P, Hirsa A (2002) Why be backward. forward equations for american options. Risk 103–107
Chang CC, Chung SL, Stapleton R (2001) Richardson extrapolation techniques for pricing American-style options. Working Paper

Cox J, Ross S, Rubinstein M (1979) Option pricing: a simplified approach. J Financ Econ 7

d'Halluin Y, Forsyth PA, Labahn G (2003) A penalty method for american options with jump diffusion processes

Figlewski S, Gao B, Ahn DH (1999) Pricing discrete barrier options with an adaptive mesh model. Working Paper

Geske R, Johnson HE (1984) The american put option valued analytically. J Finance 39:1511–1524

Hull J (2002) Options, futures and other derivatives, 5th edition, Prentice Hall, NJ

Johnson H (1983) An analytical approximation for the american put price. J Financ Quant Anal 18:141–148

Ju N, Zhong R (1999) An approximate formula for pricing american options. J Derivatives 7(2): 31–40

Lewis A (2003) American options under jump-diffusions: an introduction. Wilmott Mag

Longstaff FA, Schwartz ES (2001) Valuing american options by simulation: a simple least-squares approach. Rev Financ Studies 14(1):113–147

MacMillan W (1986) Analytic approximation for the american put option. In: Advances in futures and options research. Vol. 1, pp. 119–139

Merton R (1973a) Option pricing when underlying stock returns are discontinuous. J Financ Econ 3:125–144

Merton R (1973b) Theory of rational option pricing. Bell Journal of Economics and Management Science, 4(1):141–183

Rendleman R, Bartter B (1979) Two-state option pricing. J Finance 34:1093–1110

Richardson LF (1910) The approximate arithmetical solution by finite differences of physical problems including differential equations, with an application to the stresses in a Masonry Dam. Phil Trans Royal Soc London Ser A 210:307–357

Roll R (March 1977) An analytic valuation formula for unprotected American call options on stocks with known dividends. Journal of Financial Economics 5:251–258

Sullivan AM (2000) Valuing american put options using gaussian quadrature. Rev Financ Studies 1:75–94

Whaley R (June 1981) On the valuation of American call options on stocks with known dividends. Journal of Financial Economics 9:207–211

Chapter 15
Investing in Exotic Options

Kevin Cheng

15.1 Chapter Introduction and Objectives

In Chap. 14, we introduced the pricing of plain vanilla call and put options on dividend paying and nondividend paying stocks. In this chapter we introduce the pricing of "exotic options." This chapter has the following objectives:

- Introduce different types of exotic options
- Discuss the pricing of Barrier, Look back, Binary, Asian, and spread options

Exotic options are a class of derivative products, which allow the buyer (or seller) of the option to capture return profiles, which are more specific to their expectations or needs. Compared to plain vanilla options and stocks, exotics can have additional features or characteristics that make them more attractive in terms of both risk and reward.

Although the options market has existed for hundreds of years, it was not until the late 1970s when the Black–Scholes model (Black and Scholes 1973) was published that practitioners began to trade more extensively in derivatives. Exotic equity options began trading soon after but gained much less interest through most of the 1970s, and vanilla options and warrants were the main products traded in the markets. It was not until the 1980s and, subsequently, the introduction of over-the-counter (OTC) markets in the 1990s that interest in exotic options picked up as investors sought new ways to generate returns and help to reduce risk in portfolios.

Even though interest in options has increased, the growth of options and derivatives, particularly during the 1990s, has been held back by the portrayal of derivatives as dangerous instruments, largely due to an association with large trading losses in recent history. A number of these cases stand out: Metallgesellschaft AG's losses in oil derivatives in late 1993, the collapse of Long-Term Capital Management in 1994, Enron's bankruptcy in 2001, and, more recently, the collapse of hedge

K. Cheng
Parallax Capital Management, 1 George Street, Singapore 49145, Singapore
e-mail: kevin@global-derivatives.com

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_15,

Exhibit 15.1 Definition of notations

S	Underlying asset price
X	Strike price
r	Risk free rate
D	Dividend yield
σ	Volatility
T	Time to maturity

fund Amaranth Advisors LLC after losses exceeding US $6 billion. In most of these cases, the losses can be attributed to excessive leverage, improper risk management controls, and a general lack of understanding of these products. Nonetheless, the market for derivative products continues to grow at a phenomenal rate, leading to a demand from a wider range of investor classes, which in turn has led to the greater need for transparency and knowledge of both vanilla and exotic-type contracts.

This chapter introduces some of the concepts behind exotic options and their practical uses. Exhibit 15.1 defines the standard notation used throughout.

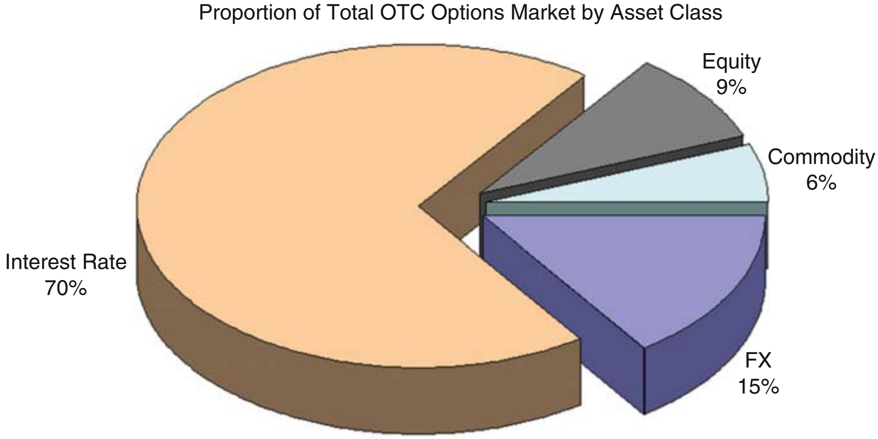
15.2 Exchange Traded vs. Over-the-Counter Market

Exchange-traded contracts refer to instruments that are traded on an exchange such as the London Stock Exchange (LSE) or the Chicago Board Options Exchange (CBOE). The contract specifications for exchange-traded options are standardized with respect to the number of underlying shares, tick size, and strikes, for example; thereby, providing a defined market place for option investors. Options which are exchange traded are primarily standard vanilla options on single stocks, America Depository Receipts (ADRs),[1] or stock indices. Only a small percentage of these options are considered exotic in nature.

The origins of option trading began thousands of years ago, but the trading of tulip options in the sixteenth century during the Dutch tulip bulb craze is often considered the first time option contracts been extensively traded. Fast forward to 1973 when vanilla options first traded on the Chicago Board of Trade (CBOT), the same year the Black and Scholes option pricing formula was announced. It was not until almost 20 years later that exchange-traded exotic options were first introduced on the CBOE in the early 1990s, followed shortly by the American Stock Exchange (AMEX), and, subsequently, brought onto other exchanges around the world. For example, S&P ASX 200 barrier options are traded on the Australian Stock Exchange (ASX). An extensive range of exotic derivatives on equities are also found on the Hong Kong Exchange (HKEX), the Stuttgart Stock Exchange (EUWAX), and the Scoach Schweiz AG [joint venture between the Swiss Exchange (SWX) and the Deutsche Börse (DBG)].

[1] American Depository Receipts are issued by foreign companies on US exchanges.

Exhibit 15.2 Proportion of total over-the-counter (*OTC*) options market by asset class



Source: BIS Quarterly Review

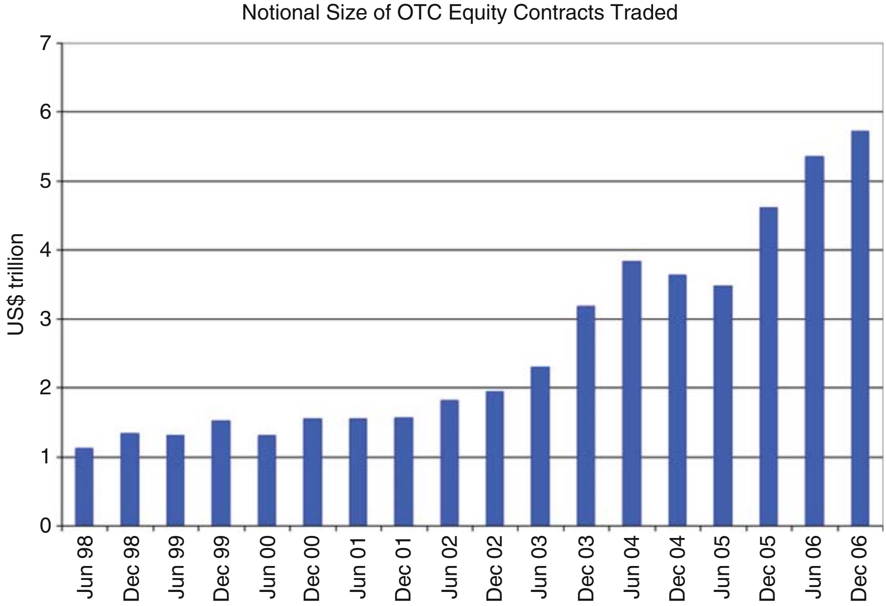
When compared to other asset classes, such as interest rate and foreign exchange, exotic equity derivatives still make up only a small proportion of all derivative contracts traded; the vast majority of which are traded "OTC." The OTC market provides a marketplace for one counterparty to trade directly with another, usually between investment banks or between the banks and their clients.

Exhibit 15.2 illustrates the relative market size of each asset class based on notional amounts outstanding as of December 2006. Looking at the percentage may not give a clear picture, but when we consider that the total size of the global derivatives market is in excess of US $400 trillion per year, even a small slice of the pie is significant.

The advent of an OTC market has led to the phenomenal growth in the OTC options traded. The Bank of International Settlements (BIS) estimates the size of the OTC equity-linked options market to be approximately US $5.7 trillion at the end of 2006 as measured by the total notional amount outstanding (Bank of International Settlements 2007), an increase of almost 58% from just 2 years earlier (see Exhibit 15.3), although a significant part of this increase can be attributable to growth in Asian equity option markets.

The primary users of exotic option instruments have been institutional investors such as banks, corporations, hedge funds, sovereign investment entities, and highly sophisticated individual investors as a way to generate additional alpha and to hedge risks. As a wider range of retail and institutional investors develop a better understanding of exotic options, the amount of equity-linked options traded is likely to rise.

Exhibit 15.3 Notional size of over-the-counter (*OTC*) contracts traded



Source: BIS

15.3 Types of Exotics and Their Pricing

Exhibit 15.4 puts the options universe into a broad perspective, grouping various examples of options into specific categories based on particular characteristics of each contract type. While no official classification exists, the table attempts to combine option complexity and the time frame in which particular options were introduced into the markets[2] as a basis for grouping.

The classification is broad but considers some of the features which affect the complexity of pricing and nature of exotic options, such as the following:

– Path dependency

  • The value of an option at expiration or exercise is dependent on the value of the underlying asset *throughout* the life of the option. A basic example of a path-dependent option is a barrier option.

– Multiple underlying assets

  • Options that have a value which is dependent on more than one underlying asset. Rainbow options are a general class of exotic options in which the value

[2] In many texts, options are categorized into simply first generation options (vanilla type) and second generation (exotics). This further categorization is intended to give an additional perspective for readers to explore specific areas of exotic options.

Exhibit 15.4 Classification of exotic options

Pre-exotic	Vanilla European and American/Bermudan options
First Generation Exotics – Traded for the past 20 years on large volumes, relatively simple to price	Barriers, Binary/Digitals, Asian, Rainbow, Spread, Lookback, Basket, Exchange, Variance-type products
Second Generation – Traded to reasonable volumes over the past 10–20 years, more complicated in pricing	Parisian/Parasian, Mountain Ranges, Passport, Cliquet, Reset, Hawaiian, Double Barriers, Power
Third Generation – Introduced in the past 5–10 years and/or purely academic exercises, pricing usually complex	Israeli, Alpha-Quantile, Mirror, Edokko/Tokyo, Whale, other exotics on exotics.
Fourth Generation – Traded in large volume in recent years, complex pricing due to high degree of path-dependency and multi-asset nature	Hybrid notes, Structured notes, Range accruals, exotic baskets,

of the option is based on the maximum (or minimum) or several assets over the life of the option.

– Time characteristics

- On a basic level, this describes the exercise type of an option (i.e., European, American, Bermudan, or window). This can also refer to features of the option which change over time or depend on time. For example, reset options have a strike which changes at discrete points over the life of the option. Other options, such as partial lookback options only consider specific periods over the life of the option for the lookback period.

This chapter focuses primarily on what we have considered to be the first generation exotics options.

To establish a pricing framework, it is necessary to consider the dynamics of both the option and the underlying asset price. For most financial assets, this is normally modeled with the use of partial differential equations (PDE). While PDEs are beyond the scope of this chapter, we briefly highlight the valuation of options in a Black–Scholes framework by first considering the underlying asset price as modeled by a lognormal random walk

$$\mathrm{d}S = \mu S\,\mathrm{d}t + \sigma S\,\mathrm{d}X,$$

where μ refers to the drift,[3] dt is the time increment, and dX follows a standard geometric Brownian motion[4]. The purpose of this equation is to explain the path of stock prices through two components:

1. A known part $\mu S dt$ (also referred to as the *deterministic* portion) and
2. A random part $\sigma S dX$ (also referred to as the *diffusion* portion).

The deterministic portion can be thought of as what we "know" the stock will do based on interest rates and dividends out over time and the diffusion is the "random" aspect of the stock process.

Through the application of Itô's lemma (Itô 1951), the process for the option can be given as

$$\mathrm{d}V = \frac{\partial V}{\partial t}\,\mathrm{d}t + \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 V}{\partial S^2}\,\mathrm{d}t + \frac{\partial V}{\partial S}\,\mathrm{d}S.$$

The bulk of option pricing problems revolve around finding a solution to the PDE (or a similar one) – in the form analytical closed-form formulae or some form of approximation. Pricing problems that do not have closed form or approximate solutions are often solved by numerical techniques.

To solve the PDE of an option, it is necessary to specify the payoff of an option as one of the *boundary conditions*.[5] The payoff is a function which shows what the terminal value of the option is at the maturity date. For example, a standard call option has a payoff of

$$\max(S - X, 0). \tag{15.1}$$

Other types of options will share the same, or similar payoff function as in function (15.1), resulting in a pricing problem based upon the application of the relevant boundary conditions for each option type.

Exhibit 15.5 shows what happens when the value of a barrier option (nonlinear) converges to its payoff function (linear) as we near maturity. The same chart can also be seen by looking at it in a three-dimensional plot (Exhibit 15.6).

Exhibit 15.5 can be viewed as a cross section of Exhibit 15.6 as we near maturity.

Similar to vanilla options, the convergence of the option value to the payoff at maturity can be explained by the benefits of owning an option. Assuming the same option specifications, holding a 1-year option today is more valuable than holding a 6-month option as there is more time for the option to be in-the-money[6] at

[3] The drift can be considered as the growth rate of the asset.

[4] Also known as a Wiener process. In short, this represents the "uncertainty" or "randomness" present in the underlying asset.

[5] Boundary conditions refer to the set of conditions (initial and final) that define the limits to the underlying asset and the option. For example, if the value of an option is the function of the underlying asset S and the time to maturity T, a boundary condition could be $V(0,T) = 0$. that is, the value of the option is zero at maturity if the asset price is 0.

[6] *Moneyness* is a generalized term used to describe the "profitability" of an option at any given time. An option which is in-the-money has positive intrinsic value, that is, the underlying stock price is greater than the strike price and positive time value. Out-of-the-money call options have zero intrinsic value as the underlying stock price is less than the strike price.

Exhibit 15.5 Convergence of barrier option value to the pay off

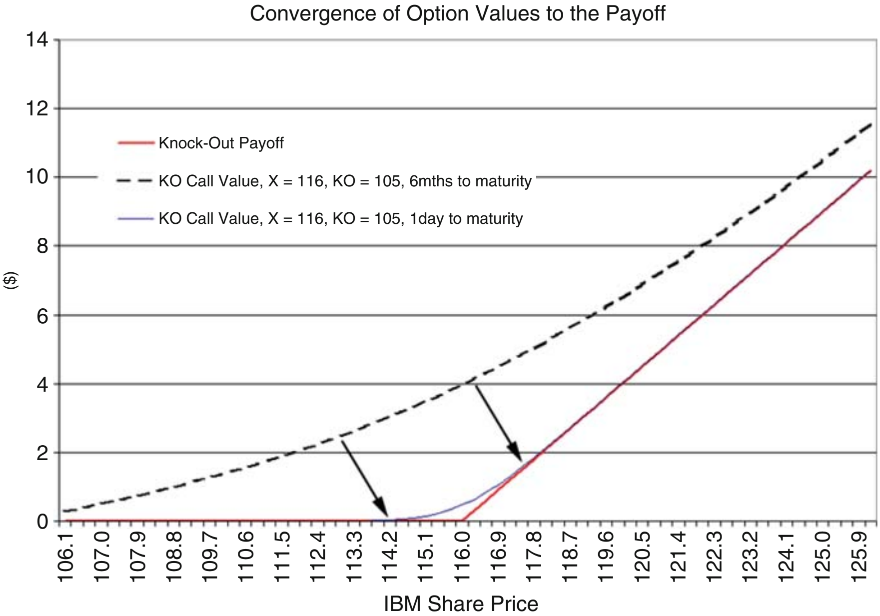
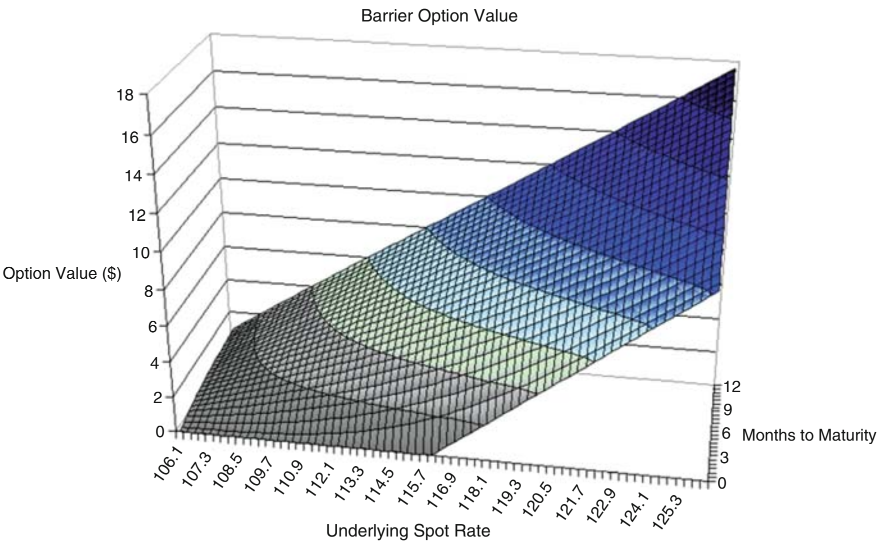


Exhibit 15.6 Three-dimensional plot of barrier option value



expiration. As we tend toward maturity, the value of holding an option diminishes up to the point that the option is worth nothing if it is out-of-the-money, and has intrinsic value otherwise. This convergence effect can be attributed to time decay.

15.3.1 Barrier (Knock-Out, Knock-In) Options

Barrier options are the most commonly traded exotic option in the equity markets. These options are having the feature of becoming terminated (*knocked-out)* or activated (*knocked-in)* when a prespecified barrier price level is reached. This barrier "knock" feature reduces the cost of these options relative to their vanilla counterpart as the option now carries a chance of being terminated *during* the life of the option (*knock-out)* or the possibility of never being activated in the first place (*knock-in)*. The closer the knock-out feature is to the underlying stock price, the cheaper the option will be. Similarly, the further away the knock-in feature is from the underlying stock price, the lower the cost of the option is.

Depending on whether the barrier is placed below or above the strike, barrier options can be further described as *down* barriers or *up* barriers – presenting a total of eight variants (four types of calls and four types of puts as follows):

Down-and-out	Up-and-out
Down-and-in	Up-and-in

To illustrate how the knock-out feature works, an investor buys a 3-month call option on the stock of GlaxoSmithKline Plc. on February 9, 2007 which was trading at £14.50. Instead of buying a plain vanilla call option, the investor decides to purchase a down-and-out call option with a strike of £14.50 and a knock-out level of £14.00. A little over a month later, on March 14, the stock price closes at £13.96 (4 pence below the barrier level), which in turn activates the knock-out feature and the option expires worthless[7] (see Exhibit 15.7).

The shaded area represents the original life of the option, and the black line denotes the barrier level. A third of the way into option, the barrier level is breached (*dotted red line*). At this point in time, the option expires and the holder loses his or her premium.

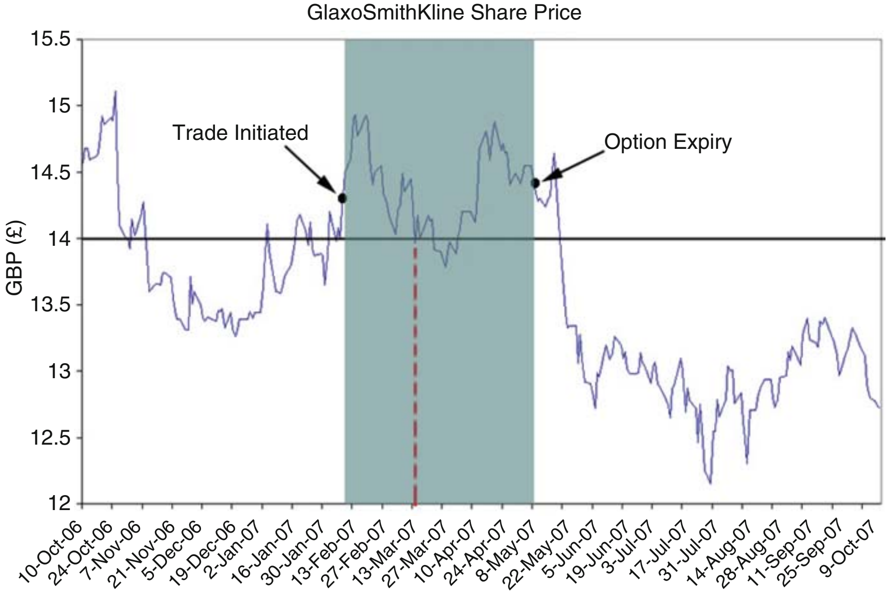
Although these are path-dependent options, they can be priced relatively easily using analytical methods described in Merton (1973) and subsequently by Reiner and Rubinstein (1991a).

15.3.2 Binary/Digital Options

A frequently traded exotic, a binary (or digital) option is a derivative contract which pays out an amount if a particular event occurs and nothing otherwise. The value of these options take a value between 0 and 1, so the prices can be thought of as probabilities of an event happening (or not happening) making these options useful in

[7] Assumes daily monitoring of the barrier. In practice, the barrier can be monitored over any period – daily, weekly, monthly, or even continuously.

Exhibit 15.7 GlaxoSmithKline share price



gauging the likelihood of an event taking place (e.g., a binary call option with strike price of \$100 priced at 0.90 implies that the market is valuing a 90% probability[8] that the price of the underlying will be at or above \$100 at maturity).

Binaries can be further subdivided into cash-type or asset-type options. Cash-type options pay a predefined cash amount if the strike price is reached and asset-type options give the holder an asset instead of a cash amount.

The payoff of a binary option is given as

Binary/digital call option: $H(S - X)$

where the function $H(\ )$ can be thought of as an activation function[9] which takes the value of 1 if the binary strike has been reached (i.e., the condition is true) and nothing otherwise. If the function is true and the strike condition has been satisfied, the holder of the option will receive a predefined payout. This generates a payoff which is extremely discontinuous around the strike price (see Exhibit 15.8).

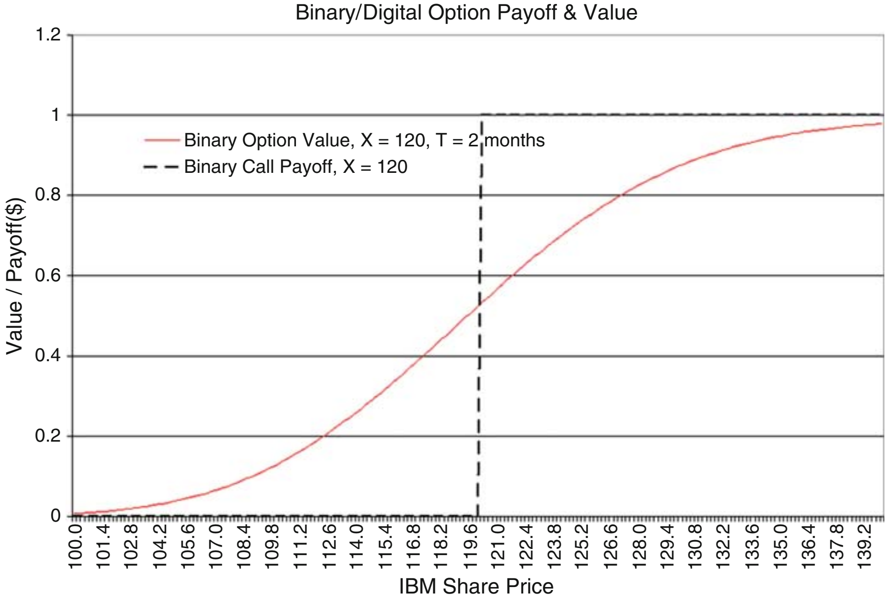
Although the payoff is discontinuous, binary options have a simple closed-form analytical solution given by Reiner and Rubinstein (1991b).

$$\text{Binary}_{\text{Call}} = \mathrm{e}^{-rT} N(d),$$
$$\text{Binary}_{\text{Put}} = \mathrm{e}^{-rT} N(-d),$$

[8] These probabilities are only approximate. The prices should be adjusted for discounting effects in order to reflect true probabilities.

[9] In fact, $H()$ is a Heaviside function, which takes the value of 1 when the argument is true (i.e., the binary strike has been reached) and zero otherwise.

Exhibit 15.8 Binary/digital option payoff and value



where

$$d = \frac{\ln(S/X) + (r - \sigma^2/2)T}{\sigma\sqrt{T}}$$

and $N(x)$ is the cumulative normal distribution function.

Binary options can also be useful in the interest rate markets. For example, 30-day Fed Fund binary options are traded on the CBOT which allow analysts and traders to estimate market expectations of US monetary policy.

Some of the variants of binary options include

Variant	Features
No-touch/range binary	The option pays out if one (or more) predetermined strikes are *not* reached during the life of the option
Digital/binary barriers	Combines the knock-out or knock-in feature of a barrier with that of a binary
Double one-touch	Must touch two predetermined levels in order for the option to pay out
Rainbow binary/digital	A binary option where the payout is dependent on more than one underlying

15.3.3 Asian Options

Also known as average rate or average strike options, Asian options are path-dependent options where the payoff depends on an average price rather than a fixed price. Certain markets or stocks can exhibit unpredictable price volatility or large jumps in stock price over time as a result of low liquidity (wide bid-offer spreads) or some significant event shocks. Because of these potential swings in stock price, an investor may prefer to have an exposure based on the *average* price of the stock over the life of the option as opposed to the final settlement price at maturity.

Several types of Asian options exist, with the two most popular being average rate options and average strike options. Average rate options give an investor a payout linked to the difference between the average stock price at a particular time and a fixed strike price, while average strike options have the strike that is based on the average price of the underlying stock and a stock price linked to the price at maturity. Examples of Asian payoffs are
Average rate call option: $\max(S_{\text{avg}} - X, 0)$ and average strike call option: $\max(S - X_{\text{avg}}, 0)$.

Because the option has a payoff based on an average of the underlying stock price (and, therefore, lower volatility of the underlying), Asian options are cheaper than vanilla options.

One feature of Asian options relates to the calculation of the average. Three common methods used are the arithmetic, geometric, and weighted average approach. Geometrically, averaged Asian options[10] have the advantage of a closed-form solution (Kemna and Vorst 1990), while approximations and numerical methods are commonly used to price arithmetic and weighted average options. See Turnbull and Wakeman (1991), Curran (1992), and Levy (1992) for more on approximations.

15.3.4 Lookback Options

Also known as hindsight options, this type of path-dependent option has a payoff which depends on the maximum or minimum the underlying asset price has reached over the life of the option (or over some prespecified time). Lookback options can be classified into two types: fixed strike and floating strike where the payoffs are defined by

$$\begin{aligned} \text{Fixed Lookback}_{\text{Call}} &= \max(S_{\max} - X, 0) \quad \text{Float Lookback}_{\text{Call}} = \max(S - S_{\min}, 0), \\ \text{Fixed Lookback}_{\text{Put}} &= \max(X - S_{\min}, 0) \quad \text{Float Lookback}_{\text{Put}} = \max(S_{\max} - S, 0). \end{aligned}$$

Fixed strike lookbacks have a strike price which is fixed at the inception of the trade and a payoff dependent on the maximum (call) or minimum (put) price of

[10] The reason for this lies in the fact that geometric rate options have an underlying price process which is lognormal, whereas arithmetic rate options do not.

the underlying stock. This type of lookback has a closed-form analytical solution (Conze and Viswanathan 1991) where the price of a call option on a dividend paying stock when $X \geq S_{\max}$ is

$$\text{Fixed Lookback}_{\text{Call}} = S\,\mathrm{e}^{-DT} N(d_1) - X\,\mathrm{e}^{-rT} N(d_2) + \frac{S\,\mathrm{e}^{-rT}}{k}\left[\mathrm{e}^{(r-D)T} N(d_1) - \left(\frac{S}{X}\right)^{-2k} N\left(d_1 - \frac{2(r-D)\sqrt{T}}{\sigma}\right)\right],$$

where

$$d_1 = \frac{\log(S/X) + (r - D + \sigma^2/2)T}{\sigma\sqrt{T}} \quad d_2 = d_1 - \sigma\sqrt{T},$$
$$k = \frac{2(r-D)}{\sigma^2}.$$

Floating strike lookbacks have a payoff based on the settlement price at maturity and the highest- (put) or lowest- (call) attained price over the life of the option. These can also be priced using a closed-form analytical solution (Goldman et al. 1979)

$$\text{Float Lookback}_{\text{Call}} = S\,\mathrm{e}^{-DT} N(d_1) - S_{\min}\,\mathrm{e}^{-rT} N(d_2) + \frac{S\,\mathrm{e}^{-rT}}{k}\left[\left(\frac{S}{S_{\min}}\right)^{-k} N\left(-d_1 + \frac{2(r-D)\sqrt{T}}{\sigma}\right) - \mathrm{e}^{(r-D)T} N(-d_1)\right],$$

where

$$d_1 = \frac{\log(S/S_{\min}) + (r - D + \sigma^2/2)T}{\sigma\sqrt{T}} \quad d_2 = d_1 - \sigma\sqrt{T}$$

and k is the same as in the fixed strike model.

Because these options take the *extrema* price, lookback options may benefit investors who are expecting large fluctuations in the stock price and has a directional outlook on the stock. For the holder of a vanilla call option, an increase in the stock is positive, but for some reason if the stock falls or dips suddenly near the maturity of the call option (especially, if the option is in-the-money), the value of the call option also falls. If the investor had held a lookback call option instead, he or she would have been able to capture the peak in the stock price without worrying about a retracement in the stock price. Lookback options reduce to need for accurate timing of the market[11] and, therefore, are more expensive than plain vanilla options.

15.3.5 Spread Options

Spread options are traded heavily in the commodities market but are often used in the equities market by investors who wish to incorporate correlation between two

---

[11] For more on the market entry/exit timing problem in relation to lookback options, see Kat and Heynen (1994).

(or more) stocks or indices in their trading outlook. These options can have their payout equal to the *difference* between two stocks where the option value changes depending on whether this difference increases or decreases over time.

The payoff functions for spread calls and puts are given as:

$$\text{Spread}_{\text{Call}} = \max(S_1 - S_2 - X, 0),$$
$$\text{Spread}_{\text{Put}} = \max(X - S_1 + S_2, 0).$$

European spread options are commonly priced using an approximation (Kirk and Aron 1995) based on the Black-76 futures option model (Black 1976), or a three-dimensional adaptation of a binomial tree.[12]

15.4 Practical Uses of Exotic Options

Investors are often faced with the fact that there is no simple answer when making a choice between several possible trading strategies. Decisions are normally based on factors such as payout potential, risk tolerance, contract complexity, or even accounting reasons. One of the methods that can help in deciding on a trading strategy is to consider a comparison between several basic strategies. In the following example, we consider three basic strategies sharing a bullish outlook on International Business Machines (IBM) shares: buying the stock outright, a vanilla call option or a knock-out option.

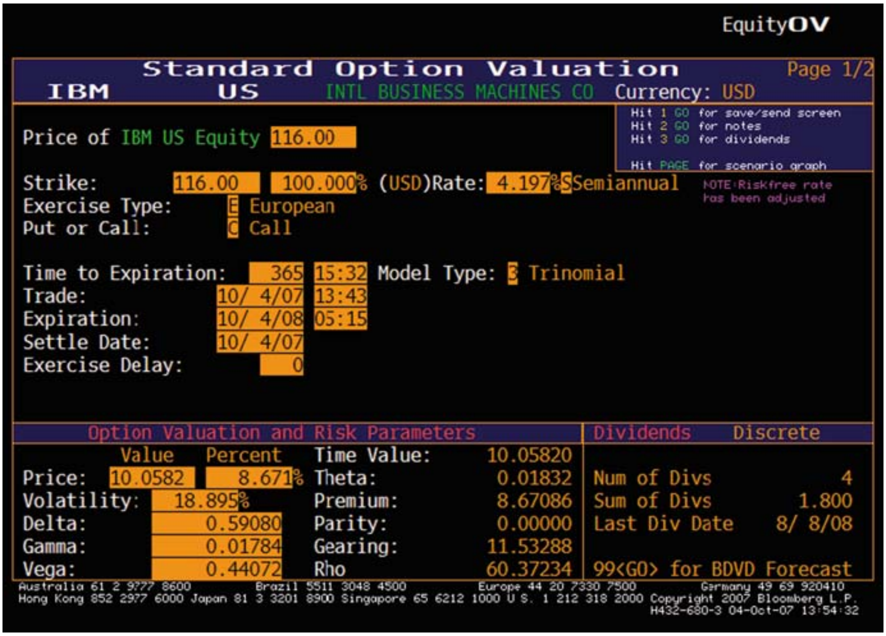
The current value of IBM stock is \$116. If an investor believes the stock will rise over the next 12 months, how could the investor express their view through a trading strategy? Three general trades can be illustrated as follows[13]:

1. The investor could buy IBM shares today and hold it for a year. The investor will make money if IBM shares rise, but could also lose money if the shares fall in value. *The most straightforward trade but with the highest potential loss, which in this case is \$116 (the value of the stock) in the event the company defaults.*
2. The second possibility is to buy a plain vanilla call option with 1 year to maturity for a fraction of the cost of buying the shares outright. The investor has a maximum loss equal to the premium paid for the option, but an upside similar to that of stock (minus the premium paid for the option). *The trade adds complexity relative to the first strategy, but the potential loss is limited to the premium, which is \$10.06.* The standard option valuation of IBM call option is shown in Exhibit 15.9.

[12] Three-dimensional binomial (or trinomial) trees are fast and accurate for European style options. See Rubinstein (1994), and Boyle (1988).

[13] There are of course many ways one can express their views in a trading strategy. The following are a generalization of possible instruments.

Exhibit 15.9 Standard valuation of International Business Machine (*IBM*) call option



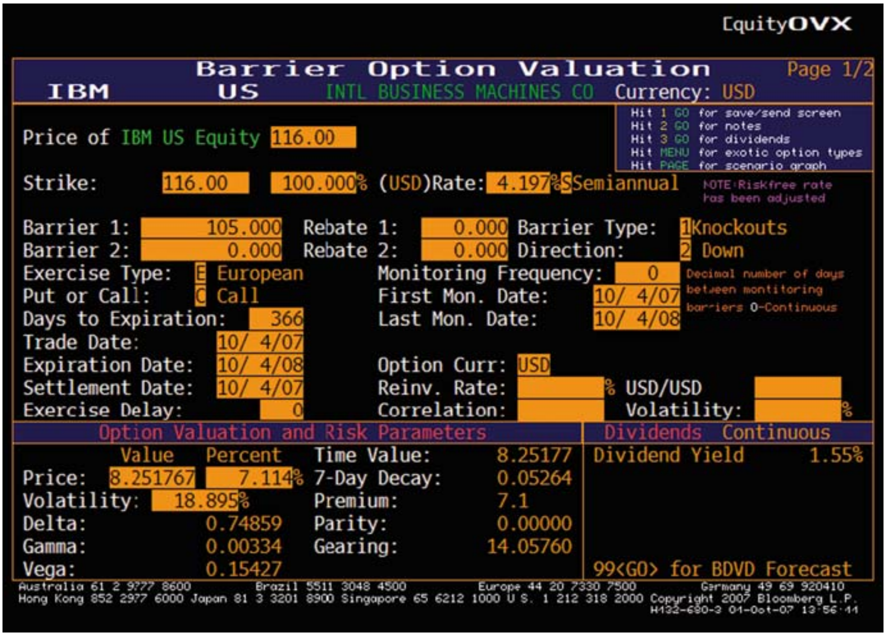
Source: Bloomberg LP

3. The investor could buy the same vanilla call option, but add a feature which terminates the option if IBM shares fell to, say $105. This is an example of a *down-and-out knock-out* barrier option. While the upside benefits are similar to the previous strategies, the option is made cheaper with the knock-out feature. Most complex of the three trades, the potential loss is capped by the premium paid of $8.25. The possibility that the option will be *knocked-out* reduces the premium. The valuation of barrier option is shown in Exhibit 15.10.

We see that the barrier option is cheaper than the vanilla option, but the possibility of being terminated in the event IBM stock falls to $105 may be an unattractive feature to the investor. For example, if the company is susceptible to large fluctuations in quarterly earning numbers, owning a knock-out will be cheaper but the chance of the option being terminated early is significant.

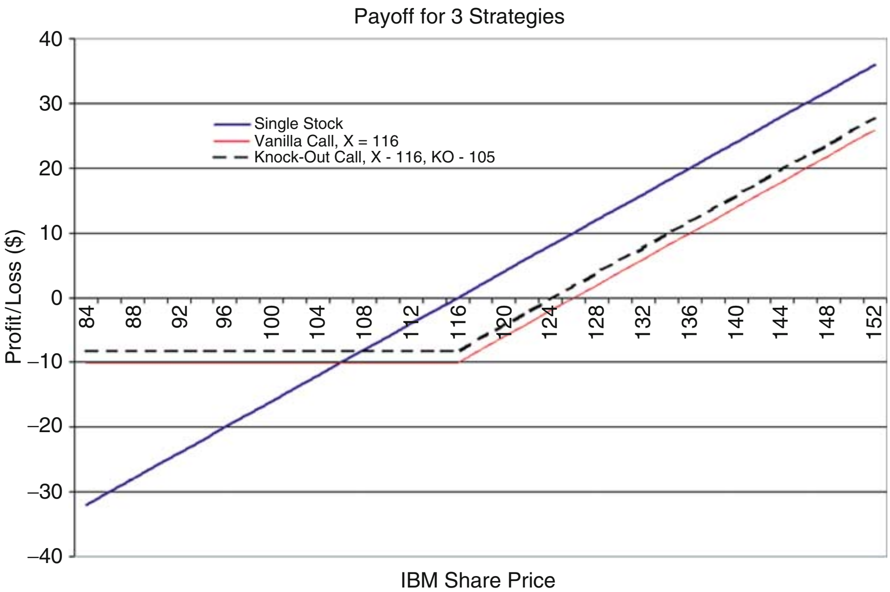
Payout profiles shown in Exhibit 15.11 illustrate the three strategies if the investor had held the three trades through the course of 1 year. From this, we can see that if IBM shares fall below $106, option strategies lose less compared to owning shares outright. At the same time the investor has the opportunity to participate if the stock performs well, albeit for a price. The decision between the two option strategies is down to how comfortable the investor is with the knock-out feature and whether or not the investor can justify the reduced cost of buying a barrier option with the risk of being knocked-out.

Exhibit 15.10 Barrier option valuation



Source: Bloomberg LP

Exhibit 15.11 Pay off for three strategies



It is important to note that while exotic options, such as barrier options, can be cheaper in theoretical price relative to their vanilla counterparts, there are certain constraints which may increase the costs of trading in practice. In the stock markets, it is not uncommon to see very tight bid-offer spreads[14] on actively traded stocks on the major exchanges. In the derivatives market, vanilla options which are actively traded will also see fairly decent bid-offer spreads with brokers taking a few hundredth of a percent (several basis points[15]) as commission. As we move into the exotic options markets where low trading volumes are more common, the bid-offer spreads can be as much as 10 or even 20 cents wide making it uneconomical to trade in these types of contracts. To further exacerbate this cost, in the event of financial distress, such as the global stock market sell-offs on 27 February 2007 or post-9/11 on 17 September 2001, it may even be impossible to find a counterparty willing to quote a price on certain exotic contracts. To make matters even more interesting, it is also necessary to consider other transaction costs, hedging costs, and liquidity risks (especially for options which are far out-of-the money) before trading exotic options on certain stocks and markets.

15.5 Term Sheet Example

Term sheets govern the specifications of an option contract and can provide an investor the details of exercise date(s), payment, strike prices, and all of the features of the option. An exotic option which allows the holder to *choose* whether to own a call *or* a put at a later date is known as a chooser option. Exhibit 15.12 shows a simplified example of a 1-month European chooser option on 2-month S&P 500 index options. In other words, this option expires in a month and gives the holder the right to either a call or a put which expires another 2 months later.

This type of option can be useful when the direction of the underlying is not clear at the time of trade, but the investor believes that a significant move in either direction may take place.

15.6 General Pricing

Exotic options are unquestionably more complex to price and manage, but are often riskier only when an investor misinterprets the risk parameters or lacks accurate pricing capabilities. The emphasis on risk is even more prominent if we consider a portfolio of exotic options on multiple asset classes.

[14] The bid-offer spread refers to the difference between the price at which you can sell at and the price at which you can buy at in the market. When someone says a stock is trading at \$24.53, they are usually referring to the mid-market price. A tight bid-offer spread could be \$24.52–\$24.54 (i.e. you can buy at \$24.54 or sell at \$24.52).

[15] 1 basis point refers to 0.01%, a common denomination used in quoting prices for options.

Exhibit 15.12 Chooser option terms

Chooser option general terms	
Trade date	10-Oct-07
Option choice date	10-Nov-07
Settlement date	12-Oct-07
Buyer	[Purchasing Party]
Seller	[Selling Party]
Option style	European Chooser
Option type	S&P 500 Call
Notional amount	US$100,000,000
Expiration date of options	8-Jan-08
Expiration time	10:00am New York
Call strike price	1,600
Put strike price	1,500
Premium	US$3,837,000
Settlement date of choice option	12-Oct-07
Expiration time of choice option	10:00am New York
Premium payable by:	Buyer
Premium payment details:	[Bank Details]
Spot rate:	1,565.15

Basic pricing methods for specific options were introduced in earlier sections, but we can extend this to outline techniques which can be applied to the pricing of exotic option in general. European vanilla options and some types of exotic options can be priced with little difficulty using closed-form analytical formulae under a Black–Scholes framework or through tree/lattice methods.[16] However, many exotic options, especially those which are strongly path dependent in nature do not have an analytical solution and require the use of more complex numerical techniques such as finite difference methods[17] to evaluate the PDE.

A powerful and flexible way of pricing options of any type is through the use of Monte Carlo simulation (MCS); whereby, the underlying asset process is simulated thousands of times in order to calculate an "average" expected payoff.[18] The inherent flexibility of MCS techniques allows us to readily evaluate a large range of options. However, one of the most central pitfalls of MCS is that it often takes many

[16] Tree methods refer to the class of methods which value an option in discrete time through a lattice. Examples of such methods include Binomial trees (see Cox et al. 1979).

[17] Finite difference schemes discretely evaluate the PDE at each time/asset step and are considered to be fast and efficient in pricing options (see Duffy 2006).

[18] By the law of large numbers, one would expect that simulating many paths will give us the expected payoff in a *risk-neutral* world. Discounting this payoff over the life of the option gives the option value.

simulations in order to attain accurate pricing[19] – especially in the case of pricing of path-dependent options. Using MCS on an exotic basket option, for example, could take minutes or even hours to complete rendering simulation methods of little value in practice. The choice of the number of simulations to use comes down to the consideration of speed versus accuracy.

Option pricing theory continues to grow as new products are introduced and the need for faster and more accurate models is sought. However, the most important aspect of option pricing is ensuring the inputs of a model are robust and knowing that the model is only as good as the inputs which go in it.

15.7 Hedging and the Greeks

Hedging an exposure typically refers to the reduction or removal of risk in an asset by trading in another instrument (usually the underlying asset). In the case of options, hedging requires one to trade in the underlying stock, a related asset, or even in another option in order to reduce the market risk of that option.

In the most basic case, the holder of a vanilla call option can hedge their risk (in the event that the stock price falls) by simultaneously selling *some* amount of the underlying stock. This amount is usually determined by looking at the option sensitivities (the option Greeks).[20] For vanilla options the interpretation of these sensitivities is straightforward, but this is often not the case when we deal with exotic options, particularly those which have discontinuous payoffs or multiple underlying assets. Furthermore, in order to maintain a perfect hedge one needs to do so continuously, that is, which requires the investor to adjust his or her hedge every time the underlying stock price changes. In practice, however, this is impossible to do and typically one adjusts his or her hedge several times throughout the day – which should be a concern for investors who trade in exotic options with discontinuous Greeks and/or payoff functions.

The Delta (the option sensitivity to changes in the underlying asset price) for a European call option is between 0 and 1 for any given price, meaning that a trader can Delta hedge his or her position by simply selling some percentage of the underlying stock (between 0% and 100%) and adjusting his or her hedge over time to maintain a net zero Delta. Similarly, the Gamma (sensitivity of Delta to changes in the underlying price) can also be hedged by selling or buying some amount of the underlying position to create a portfolio which is Delta and Gamma neutral. However, if we look at a barrier option trading very close to its barrier level very close to expiry, the Greeks can exhibit values which may not make a whole lot of sense.

[19] In recent years, variance reduction techniques and the use of low discrepancy sequences have greatly improved the speed and accuracy of MCS methods.

[20] For an insight into how Greeks can be used in trading, refer to Taleb (1996). Alternatively, Wystup (2002) looks at the Greeks of barrier options in detail, albeit from a currency option perspective.

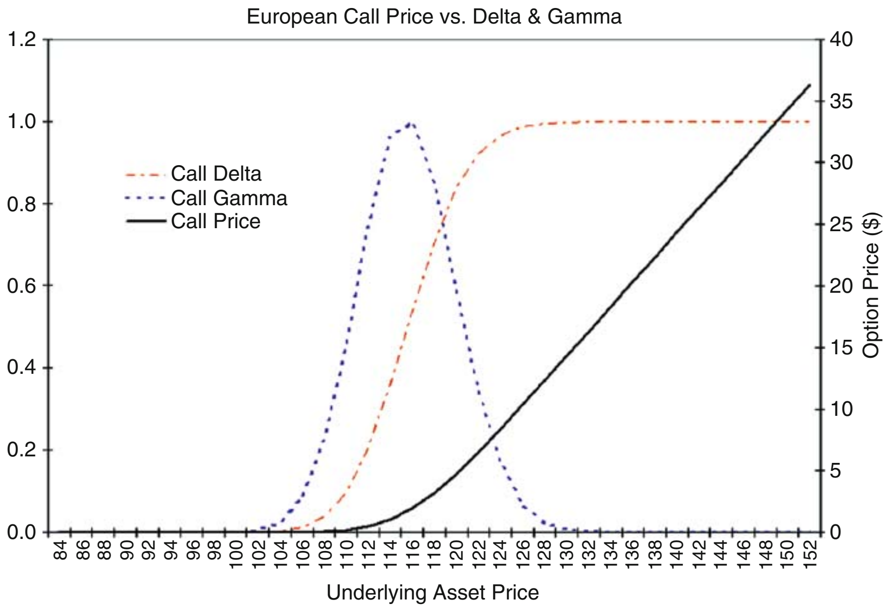
Deciding on the hedge amount at that point will depend on the trader's understanding of the Greeks (and the other sensitivities) for the particular option. Exhibit 15.13 shows that the Delta and Gamma are smooth functions relative to the option price for a European call option.[21]

For barrier options, the profile is markedly different. The first thing to note is that the Delta at the barrier is discontinuous, and more interestingly, Gamma tends to infinity at the barrier (Exhibit 15.14).

Exhibits 15.13 and 15.14 highlight the differences in hedging parameters between options. Determining the appropriate hedging instrument and identifying the correct hedge amounts are, therefore, the two most important aspects in hedging any exposure. Once these have been established, the objective of a hedging strategy is to maintain a suitable hedge without incurring significant transaction costs when rebalancing the portfolio. An optimal environment for continuous hedging is during markets in which the stock price does not fluctuate significantly during a trading session and liquidity is abundant. In practice, however, these attributes rarely hold for an extended period of time.

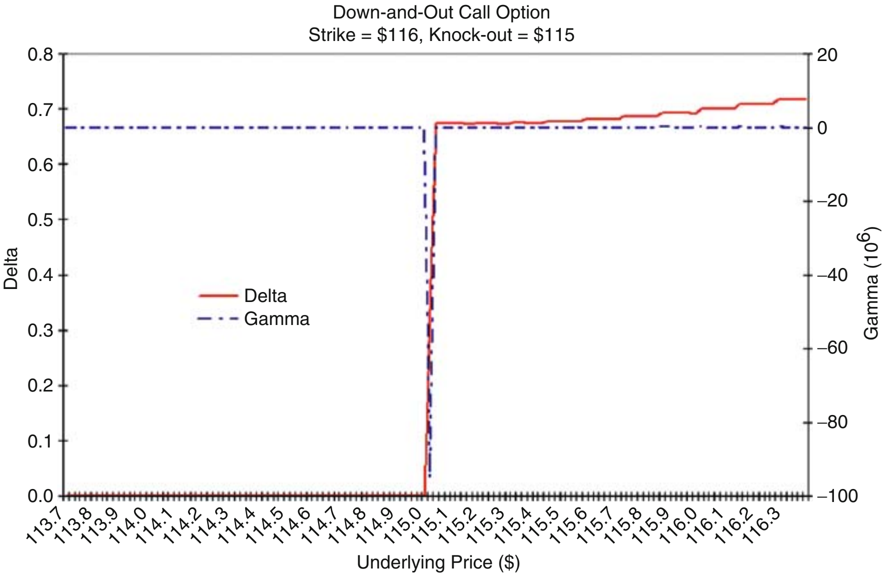
The understanding of the Greek sensitivities is critical for an equity investor trading in options. In addition to the Delta, first-order Greeks provide insights into time decay (Theta), impact of volatility (Vega), or interest rate shifts (Rho). Because of the inherent sensitivity of an option to the underlying stock price, the Gamma is

Exhibit 15.13 European call price versus Delta and Gamma



[21] Note that the Gamma has been scaled to show that the maximum Gamma occurs at-the-money.

Exhibit 15.14 Down and out call option



the most commonly considered second-order Greek but it can be useful to consider how the Vega changes with the underlying stock price (DVegaDSpot) or how the Delta changes with the time (Charm).[22] For exotic options, particularly those with discontinuous payoffs or high path dependency, the Greeks can paint a picture as to where the risks lie, and what factors can have significant impact on the portfolio.

15.8 Concluding Comments

Tremendous growth in the exotic options market across all asset classes has rendered certain types of first generation exotic options such as barrier and binary options almost vanilla in nature. With this growth expected to continue, the thin boundary separating vanilla and exotic options is likely to dissipate as investors become more familiar with pricing models and how to manage option risk on both an instrument level as well as on a portfolio level. As more products are introduced into the marketplace, the traditional asset allocation landscape is expected to change and accommodate a greater diversity of alternative assets to which exotic options will form a significant portion of.

[22] An ongoing debate amongst practitioners is the usefulness of second (or higher order) Greeks when investing in options. There is no simple answer to the debate but having a grasp of higher order Greeks is more likely to help in assessing the portfolio than not.

It is worthy to point out that only a microscopic part of the exotic options universe has been covered in this chapter and additional resources are included below as a starting point for readers to explore this area of finance in greater depth.

15.9 End of the Chapter Questions

1. What are exotic options?
2. Describe the four generations of exotic instruments.
3. Which are the three broad characteristics of exotic options?
4. Describe

   Barrier options
   Binary/digital options
   Asian options
   Lookback options
   Spread options

5. Outline the practical applications of exotic options.

References

Bank of International Settlements (2007) Semiannual OTC derivatives statistics
Black F (1976) The pricing of commodity contracts. J Financ Econ 3:167–179
Black F, Scholes M (1973) The pricing of options and corporate liabilities. J Politic Econ 81: 637–659
Boyle P (1988) A lattice framework for option pricing with two state variables. J Financ Quant Anal 23(1):1–12
Cheng K (2003) Overview of barrier options. Global-Derivatives.com, Working Paper
Conze A, Viswanathan R (1991) Path dependent options: the case of lookback options. J Finance 1893–1907
Cox J, Rubinstein M (1985) Innovations in option pricing. Options Market, Prentice-Hall, NJ
Cox JC, Ross SA, Rubinstein M (1979) Option pricing: A simplified approach. J Financial Economics 7(3):229–263
Curran M (1992) Beyond average intelligence. Risk 5:10, 60
Duffy D (2006) Finite difference methods in financial engineering – a partial differential approach. Wiley, NY
Goldman B, Sosin H, Gatto MA (1979) Path dependent options: buy at the low, sell at the high. J Finance 34:1111–1127
Hull J (2005) Options, futures and other derivatives. 6th edition, Prentice-Hall
Itô K (1951) On stochastic differential equations. Am Math Soc J 4:1–51
Kat H, Heynen R (1994) Selective memory. Risk Magazine 7:11
Kemna AGZ, Vorst ACF (1990) A pricing method for options based on average asset values. J Bank Finance 14:113–129
Kirk E, Aron J (1995) Correlation in the energy markets. Managing Energy Price Risk, Risk Books, pp. 71–78
Levy E (1992) Pricing european average rate currency options. J Int Money Finance 14:474–491

Merton R (1973) Theory of rational option pricing. Bell J Econ Manage 4
Reiner E, Rubinstein M (1991a) Breaking down the barriers. Risk 4(8):28–35
Reiner E, Rubinstein M (1991b) Unscrambling the binary code. Risk 4
Rubinstein M (1991) Somewhere over the rainbow. Risk 4:63–66
Rubinstein M (1994) Return to Oz. Risk 7:11
Taleb NN (1996) Dynamic hedging. Wiley Finance
Turnbull SM, Wakeman LM (1991) A quick algorithm for pricing european average options. J Financ Quant Finance 26:377–389
Večeř J (2001) New pricing of Asian options. Working Paper
Wystup U (2002) Ensuring efficient hedging of barrier options. Working Paper

Chapter 16
An Overview of Fixed Income Securities and Markets

S.R. Vishwanath

16.1 Chapter Introduction and Objectives

Capital markets comprise equity markets and debt markets. Debt markets are for issuance and trading of fixed income securities. Fixed income securities can be issued by central and state governments, companies, and financial institutions. Worldwide, the debt market is several times bigger than its equity counterpart. In the United States, for example, the size of the debt market is valued at more than $ 45 trillion, which, when compared to the size of the equity market, can be deemed to be an extremely huge source of capital.

This chapter has the following objectives:

- Introduce bond valuation
- Discuss measures of bond price volatility
- Introduce fixed income innovations
- Highlight the role played by credit rating agencies
- Discuss how credit risk premium can be estimated using option pricing theory

The bond market (also known as the debt, credit, or fixed income market) is a financial market where participants buy and sell debt securities, usually in the form of bonds. As of 2006, the size of the international bond market is an estimated $ 45 trillion, of which the size of the outstanding US bond market debt was $ 25.2 trillion.

Nearly all of the $ 923 billion average daily trading volume (as of early 2007) in the US bond market takes place between broker dealers and large institutions in a decentralized, over the counter (OTC) market. However, a small number of bonds, primarily corporate, are listed on exchanges.

References to the "bond market" usually refer to the government bond market, because of its size, liquidity, lack of credit risk, and, therefore, sensitivity to interest

S.R. Vishwanath
Emirates Institute for Banking and Financial Studies, P.O. Box 4166, Sharjah, UAE
e-mail: srvishy@gmail.com

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_16,

rates. Because of the inverse relationship between bond valuation and interest rates, the bond market is often used to indicate changes in interest rates or the shape of the yield curve.[1]

Like stocks, bonds are also traded on exchanges (e.g., New York Stock Exchange). The NYSE is the largest centralized bond market, representing mostly corporate bonds. The NYSE migrated from the Automated Bond System (ABS) to the NYSE Bonds trading system in April 2007 and expects the number of traded issues to increase from 1,000 to 6,000. The NYSE Bonds trading platform provides a more efficient and transparent way to trade bonds. The platform incorporates the design of the current NYSE Arca all-electronic trading system. This system provides investors with the ability to readily obtain transparent pricing and trading information, enabling them to make better investment decisions. The system has also been expanded to include the bonds of all NYSE-listed companies and their subsidiaries without the companies having to list each bond issued.

NYSE Bonds operates the largest centralized bond market of any US exchange or other self-regulatory organization. It offers investors a broad selection of bonds: corporate (including convertibles), agency, and government bonds. The majority of NYSE bond volume is in corporate debt, with some 94% in straight, or non-convertible bonds, and 6% in convertible debt issues.

The securities industry and Financial Markets Association classifies the broader bond market into specific categories like Corporate, Government and Agency, Municipal, and Mortgage-Backed, Asset-Backed and Collateralized debt obligation.

Bond market participants include institutional investors, governments, traders, and individuals.

16.2 Bond Market Indices

A bond market index is a listing of bonds or fixed income instruments and a statistic reflecting the composite value of its components. It is used as a tool to represent the characteristics of its component fixed income instruments. They differ from stock market indices in their complexity. Bond indices can be categorized based on their broad characteristics, such as whether they are government bonds, corporate bonds, high-yield bonds, and mortgage-backed securities. They can also be classified based on their credit rating or maturity.

A number of bond indices exist for the purposes of managing portfolios and measuring performance, similar to the S&P 500 or Russell 2000 for stocks. The most common American benchmarks are the Lehman Aggregate, Citigroup BIG, and Merrill Lynch Domestic Master. Most indices are parts of families of broader indices that can be used to measure global bond portfolios, or may be further subdivided by maturity and/or sector for managing specialized portfolios.

---

[1] Yield curve is discussed later.

16.3 Valuation of Bonds

The price of any asset is the present value of expected cash flows from the asset. The cash inflows in case of a bond comprise fixed or floating interest payments at specified intervals (e.g., quarterly) and the principal repayment (redemption value) at the end of the life of the bond.

Consider a 10-year \$1,000 face value bond that pays 8% interest annually. The price of the bond is obtained by discounting the interest payments of \$ 80 and principal repayment of \$1,000 at the end of the tenor of the bond.

That is,

$$\text{Price} = \$\,80 \times \text{Present Value Interest Factor of an annuity @ } k\%, 10\,\text{years}$$
$$+1{,}000 \times \text{Present Value Interest Factor @ } k\%, 10\text{ years.}$$[2]

The discount factor (k) is the discount rate appropriate for the risk class of the instrument (credit risk based on credit rating).

We would expect riskier bonds (e.g., BBB rated bonds) to carry a higher discount rate compared to the less risky (e.g., AAA rated bonds).[3]

Thus,

$$P = \frac{C}{(1+r)} + \frac{C}{(1+r)^2} + \cdots \frac{C}{(1+r)^n} + \frac{M}{(1+r)^n}$$

Where

$P =$ market price of the bond in dollars (or any other currency)
$C =$ Coupon Payments in dollars (or any other currency)
$r =$ required rate of return from the bond given the credit risk of the bond
$M =$ redemption value (usually equal to the face value)

In the previous example, if the required rate return (discount rate) is 8%, the market price of the bond would be \$1,000.

Note that the bond valuation model is very similar to the discounted cash flow methodology commonly applied in project valuation. Indeed projects are evaluated like straight bonds.

This model has certain assumptions:

- Coupon payments are made annually
- The next coupon payment is due in 1 year
- Coupon payments are fixed over the life of the bond

The model needs to be modified if coupon payments are made at other intervals (e.g., semi-annual or quarterly).

For instance, if the coupon payments are semi-annual, the semi-annual coupon payments of \$ 40 need to be discounted at $k/2\%$ for 20 semi-annual periods and the principal repayment has to be discounted for 20 periods.

---

[2] Time value tables are available in most Corporate Finance text books.

[3] Credit rating is discussed later.

16.4 Price, Coupon, and Yield Relationships

Just as in the case of a project one can find the internal rate of return (IRR) given the initial investment, cash flows and salvage value of the project, in case of a bond can find the *yield to maturity* given the prevailing market price, coupon, and redemption price. The YTM of a bond is the return an investor gets by holding the bond to maturity. This calculation is based on the premise that periodic coupon is reinvested at the yield for the remaining life of the instrument.

In the above model, it must be apparent that bond prices and yields are inversely related. That is, an increase in yields leads to a fall in bond prices and a decrease in yields leads to an increase in bond prices.

The yield can be thought of as the interest rates on similarly rated bonds with similar tenor. At the time of the issue, the issuer would set the coupon equal to the prevailing yields on similarly rated bonds (otherwise nobody would buy the instrument). Yields change as time goes on and so do bond prices. Yields may change for a variety of reasons like the following:

- Changes in the general interest rate level in the economy
- Changes in the default risk of the bond

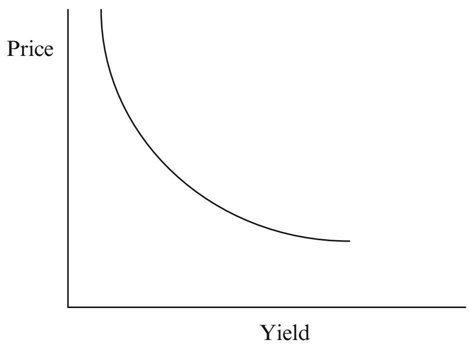
If the required yield is greater than the coupon rate, price of the bond is less than par value, that is, if $r > c$, $P < F$. This bond would be selling at a discount to face value. If the investor's expected rate of return is greater than the coupon, investors would sell the bond driving the price down until the bond offers the required yield.

If the coupon rate equals the required yield, the price would be equal to the par value. Similarly, if the coupon rate is greater than the required yield, price would be greater than par since this bond becomes comparatively attractive vis-à-vis other bonds in the market. So, investors would bid up the price.

A plot of price versus yield would have a convex shape as shown in Exhibit 16.1.

The Yield to Maturity, like IRR, is calculated by trial and error. Consider a $1,000 face value bond currently trading at $ 950. The bond carries 14% interest and has a tenor of 3 years.

Exhibit 16.1 Graphical representation of price–yield relationship



The interest rate that equates the prevailing market price and the coupon payments is the YTM. At 15% discount rate, the price works out to $ 977.62. At 16% discount rate, the price works out to $ 955.40. At a rate slightly more than 16%, the price would equal $ 950. This rate can be found using a quick-and-dirty formula:

$$\text{YTM} = \frac{C + [(F - P)/n]}{[(F + P)/2]}$$

Where

C = Coupon in $ or any other currency
F = Face value ($)
P = price of the bond
n = remaining term to maturity

For the above example, the YTM works out to

$$\text{YTM} = \frac{[140 + (1000 - 950)/3]}{[(1000 + 900)/2]} = 16.4\%$$

16.5 Nominal Versus Effective Yield

Some bonds pay annual coupon whereas some semi-annual coupon. So, it is necessary to consider the compounding effect in case of bonds that pay semi-annual coupon. The coupon paid after six months can be reinvested for another six months. Consequently, the effective rate would be more than the nominal rate.

The relationship between nominal rate and effective rate is as follows:

$$(1 + k/m)^m - 1 = \text{Effective rate}$$

Where

k = Nominal rate
m = number of times interest is compounded

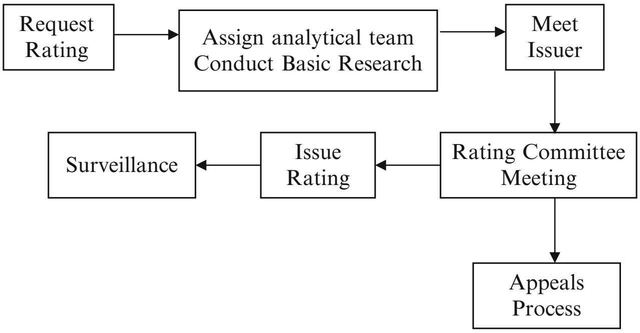
A semi-annual rate of 12% would work out to
$(1 + 0.12/2)^2 - 1 = 12.36\%$ on an annual basis

That is an investor can be indifferent between a semi-annual rate of 12% and an annual rate of 12.36%.

16.6 The Role of Credit Rating

Whenever a company sells debt it should get its issue rated by a credit rating agency such as Standard & Poor's or Moody's. The issuer approaches the agency to rate its issue and update the rating throughout the life of the issue. For this service, the

Exhibit 16.2 Rating process of S&P



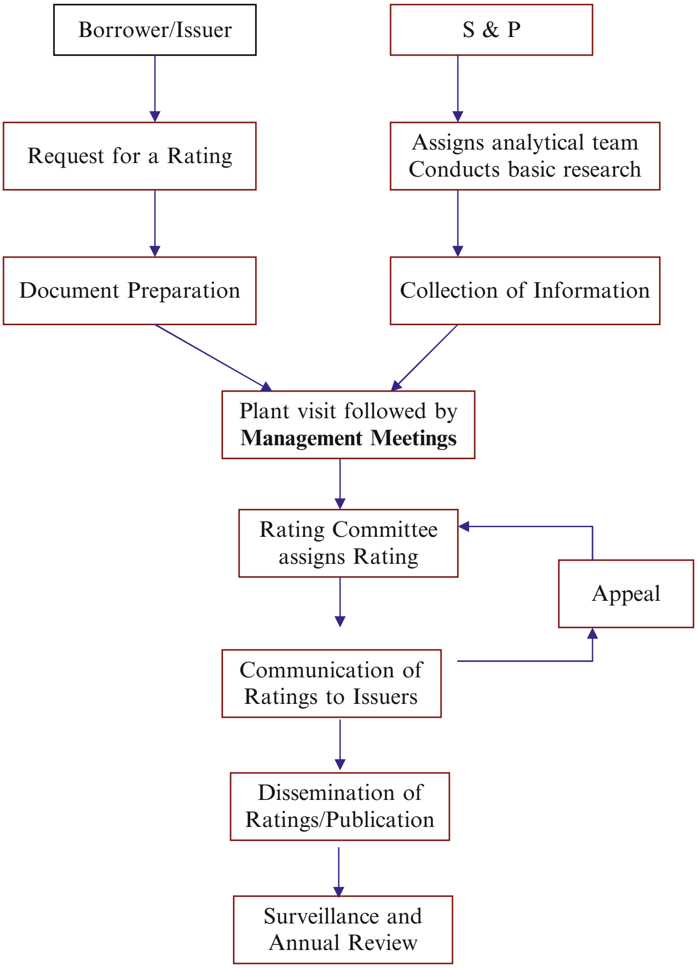
agency is paid a fee. The foundation of Credit Ratings was laid when Moody's introduced the first bond ratings as a part of Moody's Analyses of Rail Road Investments in 1909. Since then, Credit Ratings have blossomed into a full-blown business, providing investors with an impartial measure of an issuer's credit worthiness. Most financial institutions today have guidelines on investment based on the ratings issued by the major credit rating agencies. Standard & Poor's started operations in 1916. These two agencies have today come to be acknowledged as the two most influential agencies in the business. S&P was the first analytical organization to publish its ratings criteria and procedures and has been the pioneer in rating a large variety of financial instruments. It continue to be the most open about its ratings methodology, which is extensively documented. Exhibit 16.2 depicts the rating process adopted by S&P.

The rating process starts with a rating request from the issuer, followed by assigning teams and basic research, management meetings, assignment of ratings and appeal, and Surveillance and Annual Review (Exhibit 16.3). Rating agencies employ a multi-layered decision-making process in assigning a rating. They assign a team of at least two analysts who interact with the company's management.

Rating agencies believe that the interest of investors is best served if open dialogue is maintained with the issuer. Engaging the issuer in a direct dialogue not only enables to incorporate non-public information in a rating report, but also makes it forward looking. After a rating has been assigned, rating agencies monitor the ongoing performance of the issuer and the economic environment in which it operates. Surveillance also enables analysts to stay abreast of current developments, discuss potential problem areas, and be apprised of any changes in issuer's plan.

Exhibit 16.4 presents a brief description of credit rating symbols used by S&P. The credit rating is an attempt to judge the probability of default. The highest rating of AAA is given to those companies that have negligible default risk. A debt rating is not an evaluation of the issuing company but is security specific. It is supposed to assess the credit risk of a particular debt security. The rating agencies consider a variety of financial and non-financial factors to arrive at a rating. The agencies consider industry growth, global competitive position of the industry, availability of

Exhibit 16.3 The credit rating process



raw material supply, degree of regulation, and the direction of change in regulation, economic cyclicality among other factors while assigning a rating.

They also look at a number of financial ratios like interest coverage, cash flow as a percentage of total debt, and long-term debt as a percentage of capitalization to rate an issue. The amount of debt a project can support depends on the amount of cash flow the project can generate to service debt – interest and principal, credit support available to the project, and the lender's coverage requirements. Two ratios are widely used to measure a project's ability to service debt; interest coverage ratio and debt service coverage ratio.

$$\text{Interest coverage ration} = \text{EBIT/Interest}$$

Exhibit 16.4 Credit rating symbols

High investment grade	
AAA Highest safety	Bonds rated "AAA" are judged to offer highest safety of timely payment of interest and principal. Though the circumstances providing this degree of safety are likely to change, such changes as can be envisaged are most likely to affect adversely the fundamentally strong position of such issues.
AA High Safety	Bonds rated "AA" are judged to offer high safety of timelypayment of interest and principal. They differ in safety from AAA issues only marginally.
Investment grade	
A Adequate safety	Bonds rated "A" are judged to offer adequate safety of timely payment of interest and principal; however, changes in circumstances can adversely affect such issues more than those in the higher rate categories.
	S&P may apply '+' or '−' signs for ratings from AA to B to reflect comparative standing within the category.
BBB Low safety	Bonds rated BBB are judged to offer sufficient safety of timely payment of interst and principal. However, changing circumstances are more likely to lead to a weakened capacity to pay interest and repay principal than for bonds in higher rated categories.
Speculative grades	
BB Inadequate safety	Bonds rated BB are judged to carry inadequate safety of timely payment of interest and principal; while they are less susceptible to default than other speculative grade bonds in the immediate future, the uncertainties that the issuer faces could lead to inadequate capacity to make timely interest and principal payments.
B High risk	Bond rated B are judged to have susceptability to default; while currently interest and principal payments are met, adverse business conditions would lead to lack of ability or willingness to pay interest or principal.
C Substantial Risk	Bonds rated C are judged to have factors at present that make them vulnerable to default; timely payment of I & P is possible only if favorable circumstances continue.
D In Default	Bonds rated D are in default and in arrears of I & p payments or are expected to default on maturity. Such bonds are extremely speculative and returns from these bonds may be realized only on reorganization or liquidation.

It measures the adequacy of operating profits to cover interest charges. A ratio less than 1.0 indicates that earnings are not adequate to meet interest charges and hence cannot support that level of borrowing. Lenders may typically insist that interest coverage ratio never fall below 1.25.

$$\text{Debt service coverage ratio (DSCR)} = \frac{\text{EBIT}}{\text{Interest expense} + \dfrac{\text{Principal repayment}}{1 - \text{Tax rate}}}$$

While interest coverage ratio tells us how comfortable a company is in making interest payments, the firm's ability to make principal repayment is ignored. DSCR considers both. The principal repayment is not tax deductible and is to be paid out of after-tax earnings. Principal payment is adjusted to make numerator and denominator consistent (i.e., before tax). The higher the DSCR the better is the financial position, all else equal. A DSCR of less than 1.0 indicates that earnings are not adequate to meet interest and principal payments. DSCR can be further extended to include other fixed charges like lease rentals and preference dividend. Given below is the median interest coverage ratio for all the rating categories on the S&P scale (for the period 1994–1996).

	S&P
AAA	21.39
AA	10.02
A	5.67
BBB	2.9
BB	2.25

The second important ratio is the leverage as measured by debt to total capitalization. The higher the leverage the higher is the proportion of operating income that should be used to meet contractual obligations like interest payments. These agencies measure leverage in a variety of ways. For instance, another measure of leverage is (long-term debt + net worth) divided by total debt. The third important ratio is cash flow from operations to long-term debt. Debt is after all serviced from cash flows, not accounting earnings. All extraordinary sources and uses of cash are excluded to determine the overall trend in cash flow coverage. Exhibits 16.5 and 16.6 present the median ratios for all categories on the S&P scale for 1994–1996 and 1998–2000.

Exhibit 16.5 S&P's Rating of LT Debt: 1994–1996

Rating	EBITINT	FOLTD	EBITPC	OISALES	LTLEVER	TDLEVER
AAA	21.39	1.10	0.25	0.21	10.31	4.42
AA	10.02	0.75	0.19	0.17	5.29	3.53
A	5.67	0.49	0.16	0.15	3.47	2.72
BBB	2.90	0.30	0.12	0.12	3.46	2.21
BB	2.25	0.20	0.10	0.12	1.99	1.80
B	0.74	0.10	0.06	0.09	1.61	1.40

Exhibit 16.6 Median ratios of some selected accounting ratios for different credit ratings (1998–2000)

	Adjusted Key Industrial Financial Ratios US Industrial long term debt Three year (1998–2000) medians						
	AAA	AA	A	BBB	BB	B	CCC
EBIT int.cov. (x)	21.4	10.1	6.1	3.7	2.1	0.8	0.1
EBITDA int.cov. (x)	26.5	12.9	9.1	5.8	3.4	1.8	1.3
Free oper.cash flow/total debt (%)	84.2	25.2	15	8.5	2.6	−3.2	−12.9
FFO/total debt (%)	128.8	55.4	43.2	30.8	18.8	7.8	1.6
Return on Capital (%)	34.9	21.7	19.4	13.6	11.6	6.6	1
Operating Income/Sales (%)	27	22.1	18.6	15.4	15.9	11.9	11.9
Long Term debt/Capital (%)	13.3	28.2	33.9	42.5	57.2	69.7	68.8
Total Debt/Capital (including STD) (%)	22.9	37.7	42.5	48.2	62.6	74.8	87.7
No of Companies	8	29	136	218	273	281	22

16.7 Term Structure of Interest Rates

The present value of a dollar to be received in a year is less than the present value of that dollar if it were received today. We call this the time value of money. Financial markets use spot curves, forward curves, discount curves, and yield curves to describe the time value of money. These are referred to collectively as the fixed income term structure. A cash loan is a loan that commences immediately. A spot loan is a loan that commences spot. A forward loan is one that commences on some date later than spot. For example, in the Eurodollar markets a three-month spot loan commences in two business days (spot) and matures three months after that. A 2×7 forward loan commences two months from the spot date and lasts for five months. With either type of loan, interest can be paid periodically or it can be accumulated and paid at maturity.

A spot interest rate for maturity m is an interest rate payable on a spot loan of maturity m that accumulates interest to maturity. Spot rates are sometimes called zero-coupon rates because they are the rates of interest payable on obligations that accumulate all interest to maturity. Libor rates for maturities of a week or more are spot rates (GBP Libor is an exception).

Exhibit 16.7 indicates USD Libor rates for various maturities as of March 2008.

A spot curve (or zero-coupon curve) is a graph of spot rates as a function of maturity.

An $n \times (n+m)$ forward rate is an interest rate payable on a forward loan that

- Commences n months from the spot date,
- Matures m months after that, and
- Accumulates interest to maturity.

If we have a spot curve, we can calculate forward rates. Suppose we want the 3×5 forward USD Libor rate for March 1, 2008. We can calculate this from the

Exhibit 16.7 USD LIBOR rates as of March 2008

	Mar-08							
	3-Mar	4-Mar	5-Mar	6-Mar	7-Mar	10-Mar	11-Mar	12-Mar
s/n-o/n	3.15250	3.16000	3.15250	3.11563	3.09375	3.09625	3.09750	3.08125
1w	3.13625	3.13438	3.13375	3.12813	3.10688	3.08000	3.04250	2.95625
2w	3.13250	3.12500	3.12125	3.11125	3.06188	3.00250	2.96625	2.90250
1m	3.08625	3.08000	3.07500	3.05813	3.00000	2.93500	2.89000	2.86125
2m	3.04250	3.04188	3.03875	3.02875	2.98125	2.92000	2.88000	2.85875
3m	3.01438	3.00813	3.00000	2.99000	2.93875	2.90125	2.86750	2.85000
4m	2.96625	2.96375	2.96000	2.96000	2.88625	2.86188	2.82625	2.82500
5m	2.91250	2.92000	2.92500	2.92875	2.83625	2.82125	2.78250	2.80313
6m	2.86250	2.87688	2.89250	2.89250	2.78438	2.78125	2.74000	2.78750
7m	2.81000	2.83000	2.84500	2.84500	2.73875	2.73500	2.70250	2.75250
8m	2.75625	2.78188	2.79563	2.79750	2.68688	2.69000	2.65750	2.72250
9m	2.70625	2.73500	2.74625	2.75375	2.63625	2.64375	2.61375	2.68500
10m	2.67750	2.70625	2.71625	2.72875	2.61625	2.62625	2.59750	2.67125
11m	2.65063	2.67938	2.69000	2.70688	2.59875	2.60625	2.58500	2.66000
12m	2.62563	2.65813	2.66750	2.68625	2.57500	2.58875	2.57000	2.64688

Source: British Bankers Association

3-month and 5-month spot Libor rates. Let r denote the desired forward rate. We use the fact that a 5-month spot loan is financially equivalent to a 3-month spot loan combined with a 3×5 forward loan. With Libor, simple compounding is used. Based on the 3-month and 5-month spot rates and day counts as of March 1, we conclude

$$(1 + 3\,\text{month rate}\,(92/360)(1 + r(61/360) = 5 - \text{month spot loan}$$

Solving for r, we obtain the forward rate. Note that this exceeds both the spot rates. This makes sense. If there are to be no arbitrage opportunities, the combined interest from the 3-month spot and forward loans must equal the interest earned on the 5-month spot loan. If the rate earned on the 3-month spot loan is *lower than* that earned on the 5-month spot loan, then the rate earned on the forward loan will have to be *greater than* that earned on the 5-month spot loan.

A forward curve is a graph of forward rates all for the same maturity but with different forward periods. For example, a forward curve might indicate rates for $0 \times 3, 1 \times 4, 2 \times 5, 3 \times 6, 4 \times 7, \ldots, 120 \times 123$ forward loans. This would be called a 3-month forward curve.

Note that spot and forward curves provide identical information. If you have one, you can construct the other.

A third, also equivalent way to indicate the time value of money is discount factors. When we calculate the present value of some future cash flow, we are said to discount that future cash flow. A discount factor is the factor by which the future cash flow must be multiplied to obtain the present value. For example, if a EUR 100 payment to be made at maturity m has present value EUR 89.4, the EUR discount factor for maturity m is .894. Note that present values are often calculated with a spot value date. If this is the case, discount factors reflect discounting to the spot date as opposed to the current date.

Discount factors can be calculated from spot or forward rates. As an example, from the March 1, 2004 USD spot 6-month Libor rate was 1.17%. We calculate the corresponding discount factor as

$$1/[1+0.0117(184/360)] = 0.99406$$

This represents discounting from the date six months after spot back to the spot date.

A discount curve is a graph of discount factors for different maturities.

The fourth way the time value of money can be described is with a yield curve. This is simply a graph of bond yields for various maturities. The curve is typically fit in some manner to price data for bonds of various maturities trading close to par and generally of the same credit quality. Yield curves are falling out of use today. Widespread use of computers in finance makes spot curves, forward curves, and discount curves easier to construct and use in pricing work. Also, while yields continue to be widely quoted for bonds, fixed income markets are increasingly trading instruments other than bonds for which yield is either a meaningless or not useful notion. Today, when people speak of yield curves, they often mean spot curves.

16.8 Measuring Bond Price Volatility

As shown in Exhibit 16.1, the graph of bond prices versus yield is convex. For market participants who own a bond, collect the coupon and hold it to maturity, market volatility is irrelevant; principal and interest are received according to a predetermined schedule.

But participants who buy and sell bonds before maturity are exposed to many risks, most importantly changes in interest rates. When interest rates increase, the values of existing bonds fall since new issues pay a higher yield. Likewise, when interest rates decrease, the values of existing bonds rise since new issues pay a lower yield. This is the fundamental concept of bond market volatility: changes in bond prices are inverse to changes in interest rates. Fluctuating interest rates are part of a country's monetary policy and bond market volatility is a response to expected monetary policy and economic changes.

Duration and convexity are factor sensitivities that describe exposure to parallel shifts in the spot curve. They can be applied to individual fixed income instruments or to entire fixed income portfolios. The idea behind duration is simple. Suppose a portfolio has a duration of 3 years. Then that portfolio's value will decline about 3% for each 1% increase in interest rates – or rise about 3% for each 1% decrease in interest rates. Such a portfolio is less risky than one which has a 10-year duration. That portfolio is going to decline in value about 10% for each 1% rise in interest rates. Convexity provides additional risk information.

If we fit a tangent line to the curve in Exhibit 16.1, it will capture the direction and magnitude of the portfolio's sensitivity to interest rates. For small changes in interest rates, the line and the curve almost overlap. Duration is defined to be the slope of that tangent line, multiplied by negative one.

Tangent lines are the province of calculus, so we turn to calculus for the formal definition. Duration is a weighted partial derivative:

$$\text{Duration} = -1/p\,(\partial p/\partial r)$$

This leads to the approximation

$$\Delta p/p \approx -\text{duration}\,\Delta r$$

For example, suppose a portfolio has a duration of 5 years. That portfolio will appreciate about 5% for each 1% decline in rates. It will depreciated about 5% for each 1% rise in rates. It is as simple as that.

Suppose a portfolio has a duration of −2 years. The portfolio's value will rise about 2% for every 1% rise in rates. It will decline about 2% for each 1% decline in rates.

Typically, a bond's duration will be positive. However, instruments such as interest only mortgage-backed securities have negative durations. You can also achieve a negative duration by shorting fixed income instruments or paying fixed for floating on an interest rate swap. Inverse floaters tend to have large positive durations. Their values change significantly for small changes in rates. Highly leveraged fixed-income portfolios tend to have very large (positive or negative) durations.

For portfolios whose cash flows are all fixed (e.g., a portfolio of non-callable bonds) there is a particularly simple way to calculate duration. For such portfolios, duration is just the average maturity of the of the cash flows. Specifically, assume a portfolio has fixed cash flows c_i, each occurring at some time τ_i years from time 0. Let ${}^{0}pv(c_i)$ denote the present value at time 0 of the cash flow c_i, then the duration is

$$\text{Macaulay Duration} = \frac{\sum \tau_i pv(c_i)}{\sum pv(c_i)}$$

When duration is calculated in this way, it is called Macaulay duration. The Macaulay formula for duration is correct only if interest rates are continuously compounded.

Take, for example, a 5-year zero-coupon note. Because it pays no coupon, its average maturity is precisely 5 years. Hence, based on the Macaulay formula for duration, the bond's duration will be 5 years. This means that a 5-year zero will appreciate about 5% in value for each 1% decline in continuously compounded interest rates based on approximation.

In formula, all present values should be calculated using the spot interest rate for the maturity of the cash flow it is discounting.In practice, people often calculate all present values with a non-continuously compounded yield to maturity y for the entire portfolio. If this is done, formula must be modified slightly. It becomes

$$\text{Macaulay Duration} = \frac{1}{1+(y/m)} \frac{\sum \tau_i pv(c_i)}{\sum pv(c_i)}$$

where m is the frequency of compounding for the yield to maturity. For example, if the yield to maturity is compounded quarterly, $m = 4$. This formula is called modified duration.

For portfolios containing instruments that do not pay fixed cash flows, such as callable bonds, mortgage-backed securities or interest rate caps, the Macaulay or modified formulas for duration will not work. For these portfolios, other means must be employed for calculating duration.

Now let us consider convexity. If duration summarized the most significant piece of information about a bond or a portfolio's sensitivity to interest rates, convexity summarizes the second-most significant piece of information. Duration captured the fact that the graph in Exhibit 16.1 was downward sloping. It did not, however, capture its upward curvature. Convexity describes curvature.

Convexity is defined as a weighted second partial derivative

$$\text{Convexity} = \frac{1}{P} \frac{\partial^2 p}{\partial r^2}$$

16.9 Estimating Risk Premium

The required yield on a bond is the sum of a risk-free rate plus a risk premium to account for the risk of investing in bonds. The risk premium consists of default risk premium, maturity premium, and liquidity premium.

Corporate bonds are priced off treasuries. In other words, the yield on a 10-year corporate bond is set at a premium to a 10-year treasury bond. The difference between the two rates is the credit spread. The credit spread is a function of credit rating. For instance, a AAA rated bond might trade at 70 basis points over treasuries whereas AA rated bonds might trade at 90 basis points over treasuries.

A bond is essentially a package of cash flows with six month intervals. Just as in the case of projects all cash flows are usually discounted at the same discount rate (WACC), in case of bonds all cash flows are discounted at the same required rate (YTM). Intuitively, we would expect different discount rates to be applied to different cash flows because of timing differences. That is, we would expect a different discount rate for the first cash flow at six months, another cash flow at 1 year and so on.

The modified bond valuation model would be:

$$P = \frac{C}{(1+Y_1)^1} + \frac{C}{(1+Y_2)^2} + \cdots\cdots\cdots + \frac{C+M}{(1+Y_3)^n}$$

Exhibit 16.8 Treasury securities characteristics

Maturity	Coupon Rate	YTM	Price
0.50	0.00	0.08	96.15
1.00	0.00	0.0830	92.19
1.50	0.0850	0.0890	99.45
2.00	0.09	0.0920	99.64
2.50	0.11	0.0940	103.49
3.00	0.095	0.0970	99.49

In short, a bond is treated as a package of zero-coupon bonds. To derive the one period discount rate we need to construct a spot yield curve. As pointed out earlier, bonds are priced off treasuries. These spot rates are derived from treasury rates. Assume that there are five treasury instruments (Exhibit 16.8) with the following characteristics:

The first two securities are zero-coupon instruments. So the yield itself is the spot rate. That is,

6-month spot rate $= 8\%$ (annualized)
1-year spot rate $= 8.3\%$

With these, the 1.5-year spot rate can be calculated as follows:

$$99.45 = \frac{(4.25)}{(1+Y_1)} + \frac{(4.25)}{(1+Y_2)^2} + \frac{(104.25)}{(1+Y_3)^3}$$

Where

$$Y_1 = 8\%/2 = 4\%$$
$$Y_2 = 8.3\%/2 = 4.15\%$$

Solve for Y_3
Similarly, Y_4, etc. are calculated.

This methodology is applicable to treasury bonds. In order to price a risky corporate bond, it is necessary to come up with credit risk premium. The premium is added to the spot rate to estimate the present value of cash flows (i.e., market price)

$$P = \frac{C}{(1+Y_1+p)} + \frac{C}{(1+Y_2+p)} + \cdots\cdots\cdots + \frac{C+M}{(1+Y_3+p)}$$

One study by William Gebhardt et al. (2001) finds that both bond market factors like default risk beta and term risk beta and bond characteristics like bond rating and duration[4] largely explain the variation in the cross-section of bond returns. One

[4] Duration refers to the weighted average time to maturity of a bond in years. When (a modified version of) duration is multiplied by a change in yield we get approximate change in the bond

source of risk for corporate bonds arises from unexpected changes in the term structure of interest rates. The other source of risk arises from changes in default risk in response to changing economic conditions. They take the difference between the monthly return on a portfolio of long-term government bonds and 1-month T Bill return as proxy for the default risk. To estimate default and term betas they run the following regression:

$$R_{\text{it}} - R_{\text{ft}} = \acute{\alpha} + \beta_d \, \text{DEF}_t + \beta_t \, \text{TERM} + u_t$$

where

$$R_{\text{it}} - R_{\text{ft}} = \text{excess return on corporate bonds}$$

DEF and TERM are default risk and term risk factors and β_d and β_t are factor loadings (beta) for the two risk factors.

Their model also captures firm-specific default risk. They use bond ratings, Altman's Z score, and duration to measure default risk and maturity risk.

One approach to estimating default risk is to compute a composite risk measure based on a firm's financial ratios advocated by Altman (1968). His Z score model combines select financial ratios to come up with a score as follows:

$$\begin{aligned} Z = {} & 0.012 \times \text{Net Working Capital/Total Assets} \\ & + 0.014 \times \text{Retained earnings/Total assets} \\ & + 0.033 \times \text{EBIT/Total assets} \\ & + 0.006 \times \text{Market value of equity/Book value of liabilities} \\ & + 0.999 \times \text{Sales/Total assets} \end{aligned}$$

A high Z score represents a low probability of default and a low Z score represents a high probability of default. The model's classification accuracy was 95% one year before bankruptcy and 72% two years before. Accuracy of the model decreases as the time period is extended. On the basis of this study, it was concluded that firms with a Z score less than 1.81 are all bankrupt, while those with Z scores greater than 2.99 fall into the non-bankrupt group. Those that fall in between require more analysis to determine the solvency status.

16.10 Pricing Risky Debt

Shareholders, as residual claimants, are entitled to profits left over after meeting interest and principal payments. Thus, from the shareholders perspective, equity can be viewed as a call option on the value of the company's assets.[5] If the value of

price. In short, duration is a measure of bond price volatility. Duration is discussed in a subsequent section (and chapter).

[5] The option has more value when the firm is highly leveraged than when it is moderately leveraged because the probability of default is low.

Exhibit 16.9 Equity as call option

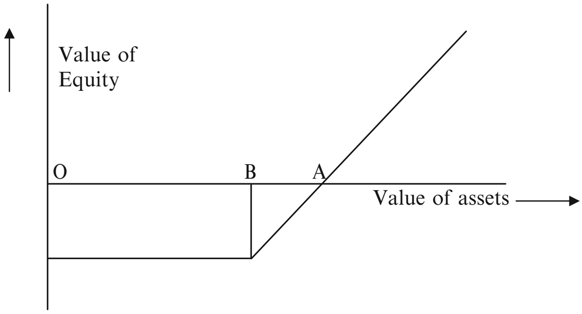
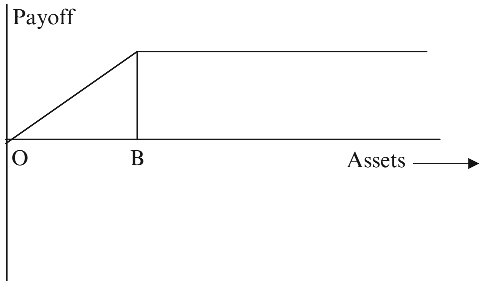


Exhibit 16.10 Debt as put option



the assets is more than the amount to be repaid to lenders at the end of the year, they get to keep residual profits; whereas if the value of assets falls short of the amount owed, they hand over the company to the lenders and walk away. The downside is limited because of the limited liability faced by shareholders. Their pay off is shown in Exhibit 16.9.

Thus, as long as the value of assets is more than OB, they get to retain profits. Similarly, the lenders position can be thought of as writing a put option on the firm's assets (Exhibit 16.10).

If the value of assets is greater than OB, the bank gets its payment, otherwise the firm's shareholders default. The bank's return is fixed whereas it can lose its entire investment.

Professor Merton in a seminal paper (Merton 1974) noted the equivalence between lending and writing a put option on the firm's assets. Just as option on stocks can be valued using the five variables that enter into the Black-Scholes model (S, X, r, t, and σ), the value of a risky loan can be found using five similar parameters, A, B, r, t, and σ_A.
Where

A = market value of firm's assets
σ_A = volatility of the market value of a firm's assets
B = market value of debt

Given these five parameters, it is possible to solve for the value of default option and the observed interest spread between a firm's risky bonds and a matched risk free treasury rate.[6]

The relationship between the yield on risky debt and risk free rate (on debt) of equivalent maturity is given by

$$k(\tau) - i = (-1/\tau)\ \ln\left[N(h_2) + (1/d)N(h_1)\right]$$

Where

$k(\tau)$ = the required yield on risky debt
i = risk free rate on debt of equivalent maturity
τ = length of time remaining to maturity
d = firm's leverage ratio as Be^{-rt}/A

$N(h)$ = a value computed from standard normal tables, it reflects the probability that a deviation exceeding the calculated value of h will occur.

$$h_1 = -[1/2\sigma^2\tau - \ln(\mathrm{d})]/\sigma\sqrt{\tau}$$
$$h_2 = -[1/2\sigma^2\tau - \ln(\mathrm{d})]/\sigma\sqrt{\tau}$$

To illustrate,

$$B = \$1\,\mathrm{m},\ \tau = 1\,\mathrm{year},\ i = 5\%,\ d = 90\%\ \text{or}\ 0.90,\ \text{and}\ \sigma = 12\%$$
$$h_1 = -0.938\ \text{and}\ N(h_1) = 0.174120$$
$$h_2 = 0.818\ \text{and}\ N(h_2) = 0.793323$$
$$k(\tau) = -1\ \ln(0.986788) = 1.33\%$$

In other words, the bond should be priced at 133 bps over the risk free rate.

16.11 Investing in Debt Initial Public Offerings

A large number of academic studies around the world have documented short-run underpricing and long-run overpricing of equity initial public offerings. That is, equity IPOs provide positive abnormal returns upon listing but underperform benchmarks over the long run (5 years).

Academic studies of debt IPOs in the United States have also documented the first day and after market performance of corporate straight debt IPOs. These studies find that IPOs of speculative grade debt are underpriced like equity IPOs while those rated investment grade are overpriced. More specifically, these studies have found that straight debt IPOs are not statistically underpriced in contrast to equity IPOs

[6] Interested readers may refer to Anthony Saunders (1999).

(Datta et al. 1997). Another study has documented a significantly negative stock market reaction to debt IPOs (Datta et al. 2000).

Investors can construct trading strategies in debt IPOs on the basis of these findings.

16.12 Fixed Income Innovations

The last two decades have witnessed unprecedented innovation in the range of and manner in which firms issue securities. Just as engineers apply scientific principles to design new products and services, financial engineers apply principles of financial economics for the purpose of structuring, pricing, and managing the risk of financial contracts.

Financial Engineering involves the design, development, and implementation of innovative financial instruments and processes, and the formulation of creative solutions to problems in Corporate Finance.

Innovative instruments make financial markets more complete and efficient. For instance, greater efficiency could be achieved by reducing transaction costs. Financial markets can be made more complete by designing a new security whose contingent after-tax returns cannot be replicated by any combination of existing securities.

Financial Engineering involves three types of activities – design of new financial instruments, development of new financial processes, and providing creative solutions to problems in Corporate Finance.

New securities can add value in several ways[7]:

Reduction in agency cost: Puttable bonds, for instance, enable investors to sell the bond back to the issuer if the issuer increases leverage beyond a certain level or when the control changes. Similarly, rating sensitive notes bear interest rates that change with the credit standing of the issuer.

Managing exchange rate and commodity price risk: Dual currency bonds are bonds offered in one currency while the interest payments and redemption are made in another currency. The issuer offers to make interest and principal payments in some specified list of currencies. The investor has the option to choose the currency DCBs thus reallocate currency risk. Likewise, commodity indexed bonds, bear coupon, and principal payments tied to the price of a commodity to which the issuer has an exposure. The issuer's revenue declines when the price of the commodity falls. So does debt service. In other words, such bonds increase the debt capacity of the company.

Reducing transaction costs: Corporate bonds usually include a call provision that enables the issuing firm to redeem the issue before maturity by paying the bondholders. When interest rates fall, managers have the option of redeeming the issue and replacing it with a new issue. Because of the call provision the issuer pays a

[7] John Finnerty (1992).

premium over face value called the call premium. The call premium typically follows a declining schedule falling to zero a few years before maturity. Issuers are typically prohibited from redeeming the issue for few years after the issue (call protection period).

Reducing inflation risk: There are many securities whose cash flows are tied to an index such as a currency index or a general price index. Inflation indexed securities are designed to provide protection against increases in prices. Usually, they are tied to a broad measure of prices such as the consumer price index (CPI) although the GDP deflator or a wholesale price index may be used. The choice depends on the needs of the issuer and the investor. The real return on these bonds is certain whereas in an ordinary bond, the nominal return is certain. In other words, inflation indexed bonds offer a fixed real return. There are two common types of bonds – Capital Indexed Bonds and Interest Indexed Bonds. Capital indexed bonds pay a fixed real coupon rate and a nominal principal that rises with inflation. Periodic coupon is calculated as the real coupon rate multiplied by inflation adjusted principal. The inflation adjusted principal itself is paid at maturity.

Floating rate instruments: These are debt securities whose coupon rates vary over time according to a predetermined formula. The coupon rate is pegged to a reference rate such as the Prime Rate or London Inter bank Offered rate (LIBOR) or T-Bill rate. The coupon rate equals the reference rate plus a mark up to reflect the credit risk of the issuer. The coupon rate is reset at regular intervals, say, 3 months. Thus, the coupon on floating rate instruments "float." The coupon is generally semi-annual. The premium over the reference rate may decline over time. For instance, the coupon might be reference rate plus 1.05% for the first 5 years, 1% for the next 5 years, and so on. There is a maximum and minimum within which the coupon can fluctuate. They can also have call and conversion features, which enable the issuer to redeem the issue on or after a pre-specified date at pre-specified prices and enable the investor to exchange the instrument to a fixed rate instrument with predetermined coupon and maturity.

Floating rate notes make coupon payments that increase with the level of interest rates, while inverse floaters make coupon payments that decrease with the level of interest rates. Inverse floaters or bull floaters have reset formulas at some fixed rate minus the reference rate. The coupon on the instrument rises when LIBOR falls. For instance, the reset formula may be 15% LIBOR. These securities attract investors who are bullish on bond prices because the coupon rate moves inversely to the market rate. Bear floaters, on the other hand, reset at a multiple of the reference rate minus some fixed rate. For instance, the reset formula could be twice LIBOR minus 9.12%. Investors who are bearish on bond prices would be attracted to such securities because the coupon rate rises by more than the increase in the market rate.

One characteristic of inverse floaters is that their prices rise more than those on fixed rate bonds of same maturity. Likewise, when rates rise, investors receive lower coupon. Who would issue inverse floaters? Those companies which have a floating rate exposure (e.g., finance companies are exposed to rise in deposit rates) would want to issue an inverse floater to smooth out the cost of funds. Combining a floater and an inverse floater cancels the variable reference rate giving rise to a fixed rate liability. These instruments are becoming popular in emerging markets as well.

16.13 Concluding Comments

In this chapter, we provided an overview of fixed income valuation, measurement of credit risk premium, and some measures of bond price volatility. In the subsequent chapters, we discuss management of fixed income portfolios and credit risk in greater detail.

16.14 End of the Chapter Questions

1. What is the relationship between coupon, yield, and price in case of bonds?
2. Why is a plot of price versus yield convex?
3. What is the relationship between nominal and effective yield?
4. Explain the meaning of different credit rating symbols.
5. Explain the methodology for calculating forward rates using a spot curve.
6. Explain the terms duration, modified duration, and convexity.
7. Explain the procedure for constructing the term structure of interest rates.
8. Explain how option pricing theory can be used in determining interest rates on debt instruments.

References

Altman E (1968) Financial ratios, discriminant analysis and the prediction of corporate bankruptcy. J Finance 23(4):589–609

Anthony S (1999) Credit risk measurement: new approaches to value at risk and other paradigms. Wiley, New York

Datta S, Mai ID, Ajay P (1997) The pricing of initial public offers of corporate straight debt. J Finance 52(1):379–396

Datta S, Mai ID, Ajay P (2000) Some evidence on the uniqueness of initial public debt offerings. J Finance 55(2):715–743

Fabozzi F (2000) Bond markets, analysis and strategies. Prentice Hall, Upper Sadddle, New Jersey

Fabozzi F (2002) Franco Modigliani, Frank Jones and Michael Ferri, Foundations of financial markets and institutions, 3rd edn. Prentice Hall, NJ

Finnerty JD (1992) An overview of corporate securities innovation. Journal of Applied Corporate Finance, 4

Gebhardt W, Soeren H, Bhaskaran S (2001) The cross section of expected bond returns: Betas or firm characteristics? Unpublished Working Paper, Johnson Graduate School of Management, Cornell University, Ithaca

Tuckman B (2002) Fixed income securities: tools for today's markets, 2nd edn. Wiley, New York

Merton RC (1974) On the pricing of corporate debt: the risk structure of interest rates. J Finance

Chapter 17
Investing in Convertibles, Preferred Stocks, and Warrants

Chandrasekhar Krishnamurti and S.R. Vishwanath

17.1 Chapter Introduction and Objectives

Convertibles are derivative embedded, hybrid instruments that get converted into the issuer's equity after some time at the option of the holder. The worldwide market for convertibles has grown enormously. In this chapter, we discuss the rationale for and the valuation of convertibles. We also compare convertibles with debt-warrant packages and preferred stocks.

This chapter has the following objectives:

- Highlight the factors responsible for the growth in convertible issuance
- Discuss the design and valuation of convertible bonds
- Introduce stock warrants and preferred stocks

A convertible bond, as opposed to a straight bond, gets converted into a fixed number of shares of the issuing company at a pre-specified price. The holder of a convert is entitled to receive interest on the convertible portion till conversion. Thus, a convert is a package of straight debt and equity option. The option to convert is usually at the discretion of the holder and will only be exercised when and if the holder finds such an exercise desirable. The features (terminology) of a convertible bond are discussed below.

17.2 Features of a Convertible Bond

The stated value or par value of a convertible security is typically $1,000 in the United States whereas Preferred stocks have much lower par values – $ 50 or $ 25.

C. Krishnamurti (✉)
AUT University College of Business WF Building, Wellesley Campus, 42 Wakefield Street, 1010, Auckland, New Zealand
e-mail: Chandrasekhar.krishnamurti@aut.ac.nz

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_17,

The number of shares a holder will receive on exercising the option is called conversion ratio.[1] The price paid to acquire the underlying shares through conversion is called conversion price.

$$\text{Conversion ratio} = \frac{\text{Par value of security}}{\text{conversion price}}$$

To illustrate, if the par value were to be \$1,000 and conversion price, \$100, the investor will receive 10 shares.

The conversion value of a convert is the value of the bond if it is converted immediately.

$$\text{Conversion Value} = \text{Market price of shares} \times \text{Conversion ratio}$$

Conversion premium is the difference between the conversion price and the current market price of the stock at the time of issue. The premium is expressed in percentage. To illustrate, if the conversion price is \$ 50 and the current market price of the stock is \$ 40,

$$\text{Conversion premium} = \frac{\$50 - \$40}{\$40} = 0.25 = 25\,\%$$

Conversion premium may also be calculated as

$$= \frac{\text{Convertible Price} - \text{Conversion Value}}{\text{Conversion Value}}$$

Although conversion premiums range from 10% to 70%, a premium in excess of 30% is considered too high to attract the traditional convertible band investors.

The *current yield* of a convert is the coupon payment on the bond expressed as fraction of the current market price. Thus, if coupon payment is 4% and market price is \$100, yield is 4%. The current yield is usually set higher than the dividend yield on the company's stock. Breakeven measures the time it would take for the added return on the convert to equal the premium paid for the security in excess of its parity.

$$\text{Breakeven} = \frac{\text{Convertible market price} - \text{Conversion value}}{\text{Convertible coupon} - (\text{Stock dividend} \times \text{conversion ratio})}$$

[1] There is a class of convertibles called death-spiral convertibles which convert into a fixed dollar amount of common stock (equal to the convert's price). They derive that name from the fact that when stock price falls, the death-spiral owners receive more shares because of which shareholders face severe dilution. The terms of these bonds are so onerous that only companies desperately in need of cash would consider them. Some 23 companies issued death-spirals and raised \$123 m in 2001 in the United States.

The coupon payments on convertibles are tax deductible for the issuer and rating agencies assign varying degrees of equity content depending on the structure of the instrument. Coupon typically ranges from 4% to 6%.

Convertible price is the current market price of the security quoted as a percentage of par for bonds and an actual dollar price for preferred stocks. The price of the convert changes as the common stock price changes depending on the relationship between the convertible price and its equity value. A glossary of convertible bond terms is given in Appendix 1 at the end of the chapter.

The credit spread (over treasuries) reflects the investor perception relating to how likely the issuing company will be able to make timely interest payments and payoff the principal at maturity. The larger the spread, the more concern investors have regarding the issuing company's ability to make timely interest payments. The smaller the spread, the less concern investors have. An example to illustrate these concepts is given below.

Most convertibles are senior unsecured debt, ranking pari passu with similar obligations of the issuer, although investors need to be aware of the actual issuing entity and any relevant guarantees. Some convertibles are structurally and/or contractually subordinated, and may contain features that optimize accounting and/or tax treatments, including several mandatory and subordinated perpetual convertibles.

An example

Stock price	= $20
Stock dividend	= 0%
5-year treasury yield	= 2.95%
Assumed credit	
Rating	= BBB+
Credit spread	= 250 bp
Stock volatility	= 40%

New issue terms

	Pricing	Price talk
Coupon	3%	2.75–3.25%
Conversion premium	25%	23–27%
Call protection	3 years	
Call price	101.20%	
Maturity	2008	
Issue price	$ 1,000	
Conversion price	= Stock price at issue × (conversion premium + 1)	
	= $ 20(0.25 + 1)	
Conversion ratio	= Face value/Conversion ratio	
	= $ 1,000/$ 25	
	= 40	
Investment value	= Present value of convertible cash flows	

(Pure bond value)	= PV (semi-annual 3% coupon for 5 years, par value of \$ 1,000 discounted at 5-year treasury rate (2.95%) plus credit spread (2.5%)
Premium over Investment value	= (Convertible price/Investment value) − 1 = (100%/89.4%) − 1 = 11.85%
Parity (conversion value)	= conversion ratio × stock price = 40 × \$ 20 = \$ 800
Point premium	= Convertible price − Parity \$ 1,000 − \$ 800 = \$ 200 or 20 points
Conversion premium	= Point premium/Parity = 20/80 = 25%
Income pick up	= Coupon − (Conversion ratio× Stock dividend) = \$ 30 − (40 × 0) = \$ 30 or 30 points
Breakeven	= Point premium/Pick up = 20/3 = 6.67years

Hybrid securities have been a major growth area in the United States and European capital markets over the past decade. The global convertible bond market is estimated to be \$ 610 b in size with North America accounting for \$ 325 b, Europe accounting for \$ 177 b, Japan accounting for \$77 b, and non-Japan Asia accounting for \$318 b. The US convertible bond market has grown from \$ 79 b in 1991 to \$ 305 b at the end of 2003. Issuance in Europe in 2006 was expected to match the EUR6 billion of 2005. Data from Thomson Financial show EUR50 billion raised globally in the first half of 2006, compared with just over EUR56 billion for all of 2005.

Exhibit 17.1 presents the growth in the size of the convertible bond market between 1991 and 2003. Asia will continue to grow in importance concurrent with

Exhibit 17.1 Estimated market value of convertible bonds

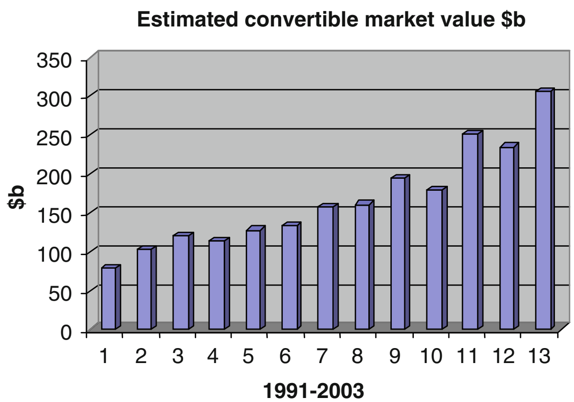


Exhibit 17.2 Historical returns for convertible bonds, treasuries, and indices for the period December 31, 1989 through February 27, 2004

Asset Class	Monthly return %					
	Sharpe ratio	Correlation[a]	Risk %	Reward %	Max	Min
Morgan Stanley Convertible Index	0.46	1.00	12.86	10.78	15.33	−13.41
Russell 2000	0.32	0.85	19.05	10.89	16.53	−19.39
S&P 500	0.41	0.78	14.86	10.98	11.44	−14.44
MS Corp Bond Index	0.81	0.26	4.70	8.70	−3.32	8.06
10 Year Treasuries	0.33	0.02	8.00	7.53	−7.07	12.76

Source: Morgan Stanley

[a]Correlation with the convertible index; Sharpe Ratio is discussed in the chapter on Measuring Mutual Fund Performance. It is the ratio of excess return on a security (over and above the risk free rate) and the standard deviation of excess returns measured over some time period

higher GDP growth rates, general acceptance of the asset class, and increasing maturity of capital markets. Convertible issuance declined significantly in 2004 in both Europe and the United States, for example, for several reasons.[2] First, many companies have been deleveraging, which arguably compromises their need to seek growth in lacklustre markets. Second, there were uncertainties surrounding accounting standards for equity-linked products under International Accounting Standards. Third, many issuers prefunded themselves during 2003, including via the convertible market. Finally, lower volatilities have likely deterred some issuers.[3] But this is only part of the story, since volatilities are correlated with credit spreads, which were at historically tight levels. So, while convertible issuers lament the low volatility, the tight spreads and low interest rates are a boon. Issuers who wait for volatilities to rise, risk seeing spreads and interest rates widen in tandem. This is indeed what happened in 2005–2006.

Exhibit 17.2 gives relevant statistics on the performance of convertible bonds as an asset class. As can be seen converts have earned more than stocks (as represented by the S&P 500 index) though we would expect stocks to do better than converts because they are riskier.

17.3 Convertible Versus Exchangeable Bonds

While a convertible bond converts into new shares of the issuer, an exchangeable bond converts into existing shares of the issuer or a third party. That is, a company that intends to dispose off its holding in another company can issue an exchangeable

[2] Credit Forum on convertibles, Credit Magazine, Vol 5 Issue 10, August 2004.

[3] Lower volatilities in stock prices result in lower convertible premium.

bond that converts into the shares of that company. However, both products can be structured as a pure financing alternative. A convertible defers capital increase (dilutive) and the exchangeable bond is a disposal tool (non-dilutive, except in some instances Treasury shares), so that investors can "sell" the shares at a premium today but keep the dividends and voting rights until delivery. In many cases, the convertible has a longer maturity, while the exchangeable is typically structured with a shorter maturity.

The disposal of large stock holdings via exchangeable bonds has been a major market pattern. Combined stock and exchangeable bond placements have paved the way for issuers to dispose of large holdings. Government privatizations have accelerated this trend. Exchangeable bonds primarily serve as a disposal tool whereas convertibles are a financing and gearing tool. Firms looking to raise equity would issue a convertible. Convertibles can be structured in order to obtain "equity credit." Exchangeable bonds do not necessarily enhance the credit risk profile of the company. A major advantage of exchangeable bonds is that they do not dilute shareholders while providing attractive equity-linked financing. Funding via convertibles may not be favorable if the issuer has a low volatility. Holding highly volatile stock, however, can be exploited by launching an exchangeable.

17.4 Determinants of Convertible Bond Value

Since a convertible is a hybrid instrument consisting of bond and option components, we would expect the value of the convertible to increase as the underlying stock price increased and decrease whenever the stock price declined. Although, theoretically the price of the stock can be anything, including zero, the downside in case of convertibles is limited because of the straight bond component that provides contractual coupon payments. This serves as an investment floor.

The fixed income component of the convert is determined by discounting coupon and principal payments at an appropriate discount rate. The discount rate is usually the yield on a straight bond of similar maturity and credit rating. This value is termed Investment Value. The investment value premium is the amount that the market price of the convertible is above its investment value, expressed as a percentage. Exhibit 17.3 depicts the hybrid nature of convertibles.

All convertible bonds and preferreds with premium over investment value less than or equal to 10% are considered credit sensitive. All convertible bonds and Preferreds with conversion premium less than or equal to 10% or delta greater than or equal to 75% are considered Equity sensitive. Those that fall in between are considered middle-of-the-road. The Venn diagram in Exhibit 17.4 depicts these.[4]

[4] Correlation with the convertible index; Sharpe Ratio is discussed in the chapter on Measuring Mutual Fund Performance. It is the ratio of excess return on a security (over and above the risk free rate) and the standard deviation of excess returns measured over some time period.

Exhibit 17.3 Hybrid nature of convertibles

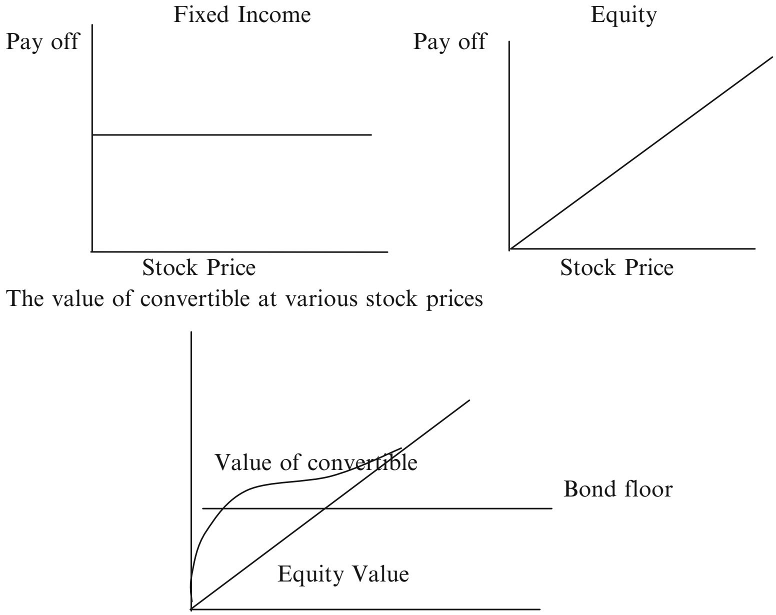
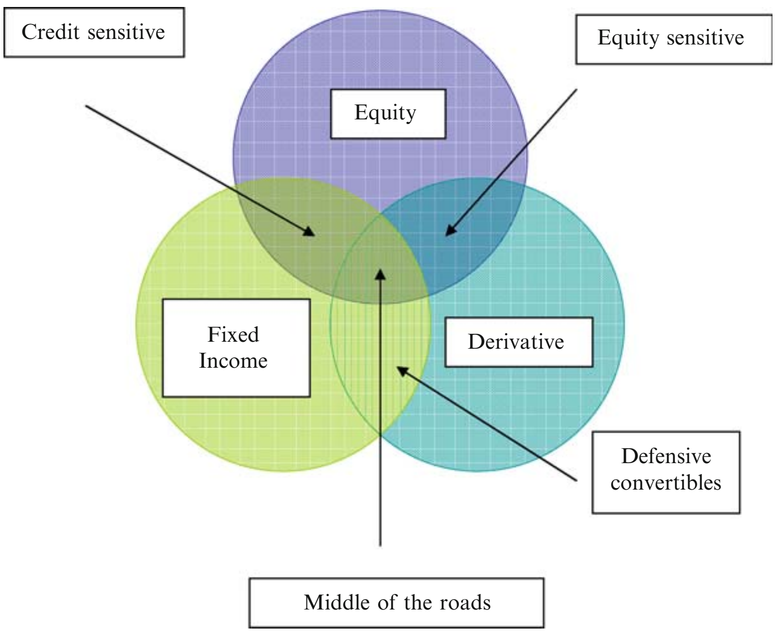


Exhibit 17.4 Types of convertibles



The sensitivity to changes in the stock price is called Delta. It expresses the change in the convertible price per unit change in the underlying common stock price. The change in delta per unit change in stock price is called Gamma. Convertible bonds also come with call provision that enables the issuer to repurchase the bond from security holders at the option of the issuer. Converts also come with a call protection period during which the issuer cannot call the bond. A bond's call schedule sets out the dates and prices at which the bonds could be called. If the call price is below the conversion value, the issuing company can force conversion by calling the bond. The investor would be forced to convert the bond because she or he gets more by converting than redeeming. Converts also come with what is known as soft call protection which stipulates that a bond be called only if the underlying stock price is at a pre-specified level, say 125% of the conversion price.

A list of *Equity Sensitive* convertibles at least \$200 MM in size, at least 6 months of call protection, and breakeven less than 6 months beyond call protection (at the time of writing) is presented in Exhibit 17.5.

A list of *Credit Sensitive* convertibles at least \$150 MM in size, stock price of \$ 5.00 or more is presented in Exhibit 17.6.

A list of middle of the road convertibles is presented in Exhibit 17.7.

Most convertibles are senior unsecured debt, ranking pari passu with similar obligations of the issuer, although investors need to be aware of the actual issuing entity and any relevant guarantees. Some convertibles are structurally and/or

Exhibit 17.5 Equity-sensitive convertibles

Issuer	Coupon%	Maturity	Current yield	Conv. ratio	Conv.prem %	Break even yrs
Capital One	3.13	5-17-05	7.31	0.64	29.9	3.2
El Paso	4.50	08-16-05	9.64	2.09	24.3	2.3
FPL Group	4.00	2-16-06	8.21	0.74	22.5	3.9
Prudential	3.38	11-15-04	6.07	1.47	19.5	2.7
MetLife	4.00	05-15-03	4.69	2.97	3.6	0.9
Phelps Dodge	6.75	08-15-05	6.66	2.08	25.0	3.0

Source: Morgan Stanley

Exhibit 17.6 Credit-sensitive convertibles

Issuer	Coupon%	Maturity yield %	Current prem.%	Conversion Prem.%
Hilton Hotels	5.00	5-15-06	5.32	64.7
Amazon.com continental	4.75	02-01-09	7.20	222.9
Airlines	4.50	02-01-07	6.73	117.7
Calpine	4.00	12-26-06	5.84	123.8
Xerox continental	0.57	04-21-18	1.05	990.6
Airlines	4.5	02-01-07	6.73	117.7
Calpine	4.00	12-26-06	5.84	123.8

Source: Morgan Stanley

Exhibit 17.7 Middle-of-the road convertibles

Issuer	Coupon%	Maturity	Current yield%	Conversion premium
Ford Motors	3.25	1-15-32	6.64	36.1
General Motors	1.13	3-06-32	4.57	47.4
A Cummins	3.50	6-15-31	7.59	44.8
Navistar Cooper	4.75	4-01-09	5.38	60.6
Cameron	1.75	5-17-21	1.87	95.4

Source: Morgan Stanley

contractually subordinated, and may contain features that optimize rating agency, accounting and/or tax treatments, including several mandatory and subordinated perpetual convertibles.

17.5 Who Issues Convertibles?

Convertibles are issued by both small cap and large cap firms although small cap firms are general candidates. Twenty percent of the S&P constituents have convertibles outstanding. Among the large companies AIG, AIG Berkshire Hathaway, UPS, General Motors, and Ford have issued. Among growth firms Amgen, Genzyme, Nortel, Lucent, Yahoo, and Computer Associates have issued. Convertibles are also issued by companies undergoing restructuring.

Convertible issuance was $ 89.4 b in 2003, the second largest year in the market's history. New issuance in 2004 was expected to be in the range $60–$70 b. Exhibit 17.8 presents the statistics on convertible issuance between 1995 and 2003.

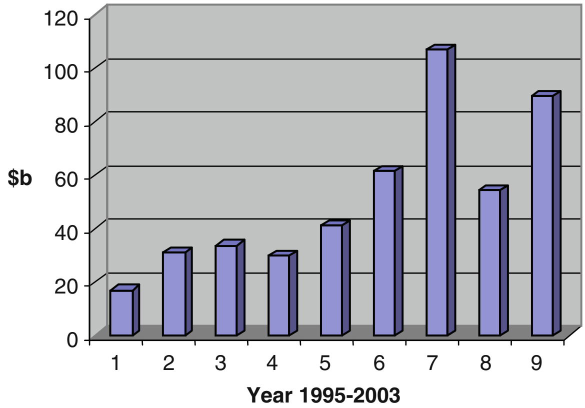
Issuers are attracted to convertibles because of low coupon, high conversion premium, and easy covenants. Likewise investors are attracted to those issues that provide relatively higher coupon,; have low conversion, and strong covenants.

17.6 Who Invests in Convertibles?

The investor base for hybrid issuance is largely the same as that for corporate senior debt: money managers, credit fund managers, banks, pension funds, and hedge funds. For some European life insurance companies, particularly those in France and Germany, hybrid issuance cannot be held within their investment (non-mark-to-market) book.[5] It means that they are taking market risk and credit risk, which necessarily influences the extent of their interest in the product. It makes

[5] Hybrids: Back on Track, Credit Magazine, November 2006.

Exhibit 17.8 Convertible issuance between 1995 and 2003



it a difficult product to hold given their need for asset/liability matching. In contrast, Dutch and UK insurers are obliged to mark everything they hold to market and while the higher volatility of hybrids does pose some problems for them, the high yields available make hybrid an attractive investment.

Convertibles appeal to both traditional equity and fixed-income investors, though often for different reasons. Equity investors tend to view convertibles as a species of share that offers an element of downside protection. The right of the holder not to convert but allow the bond to be redeemed for cash at maturity can be thought of as a put option. Bond investors, on the other hand, see convertibles as instruments that have the capacity to deliver much higher returns than other fixed-interest securities due to participation in the performance of the underlying shares. The right to convert can be interpreted as a call option. Hedge fund managers, who have become big buyers of these instruments, view convertibles as an amalgam of sensitivities that can be hedged selectively. The convertible's value is influenced not only by share prices, bond yields, and credit spreads but also by dividends and (importantly) option valuations. The hedge fund manager who perceives value in the option element of a convertible will attempt to extract that value by dynamic hedging of the share exposure: selling on share price rises and buying on dips.[6]

17.7 Convertible Security-Type Overview

Convertible bonds, as described so far, are debt instruments with an embedded option. Convertible preferred stocks, though share certain characteristics of convertible bonds, are subordinated to convertible bonds. Typical coupons are in the range of 6–7%.

[6] Education: Back to Basics, Credit Magazine, October 2006.

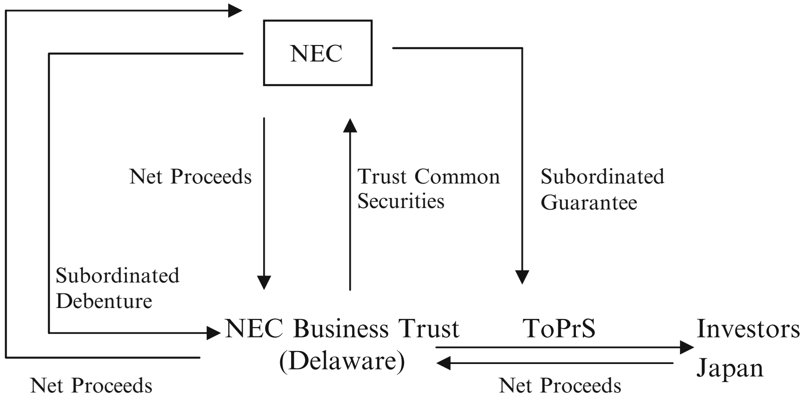
Cash coupon bonds are convertibles derive more than 70% of their value from the bond component and less than 30% from the option value. These carry higher yield than common stock and the investment value cushions the downside.

Zero coupon bonds can either be secured or be unsecured. Zero coupon bonds are issued at a large discount from the face value. This is because zero coupon bonds pay all the interest at maturity, making no payments until they mature. Zero coupon bonds offer quite a few advantages to bond investors. A zero coupon bond has the advantage of being free of reinvestment risk, although there is no way to enjoy the effects of a rise in market interest rates. Zero coupon bonds are conducive to being sensitive to and fluctuations in interest rates, because there are no coupon payments to reduce the impact of interest rate changes. In addition, markets for zero coupon bonds are relatively illiquid. Under US tax law, the assumed interest on a zero coupon bond is taxable as it accumulates, even though there is no cash flow. A zero coupon convertible is similar to a ZCB except that they have an option embedded in them. These derive 90% of their value from the bond component and 10% from the option value.

A convertible preferred typically pays a cash coupon on a quarterly basis, and is also perpetual or with a long maturity.

Trust Preferred Securities represent a form of hybrid financing (financing with both debt and equity characteristics) that has already developed to a considerable level of primary and secondary volume in the United States and Europe. In November 2001, NEC was planning to raise a total of 200 billion Yen in the United States and overseas markets. In that transaction, a business trust established in the United States and 100% controlled by NEC raised funds by offering the Trust Preferred Securities primarily to Japanese retail investors. At the same time, the business trust would invest all such proceeds in subordinated debentures issued by NEC. Effectively, NEC would have raised funds as if it had directly issued the Trust Preferred Securities. Unlike ordinary bonds, the Trust Preferred Securities have certain equity-like features such as having no predetermined maturity (the Trust Preferred Securities do not have a predetermined maturity although they may be redeemed at the option of NEC beginning five years from the issue date. NEC believes it will be able to exercise this option only after it has sufficiently built its equity base through retained earnings or other methods), ranking junior to ordinary debt in the event of liquidation of NEC (the Trust Preferred Securities will be senior to ordinary shares), and allowing deferral of distributions for a certain period of time if NEC suspends dividends on its ordinary shares. As a result, the Trust Preferred Securities offer a higher yield (2.4% $\sim$ 2.9% for the first five years) compared to ordinary bonds. At the same time, the Trust Preferred Securities are different from ordinary shares since distributions are at a fixed rate or determined on the basis of market interest rates rather than being linked to NEC's performance, so that the market price is not directly linked to the changing performance of NEC, and since there are no voting rights. As a result, the Trust Preferred Securities do not dilute return on earnings or voting rights for existing shareholders. NEC obtained confirmation from the major rating agencies that they will recognize a considerable level of "equity credit" for the hybrid features of the Trust Preferred Securities. The structure of the transaction is shown in Exhibit 17.9.

Exhibit 17.9 NEC Trust preferred securities



The terms of the NEC issue are given in Appendix 2 at the end of the chapter. In addition to the Trust Preferred Securities, NEC offered 100 billion Yen of Euro Yen Convertible Bonds mainly to institutional investors in the Euro market. The terms of the NEC issue are presented in Appendix 3.

Mandatory convertibles are equity-linked securities that pay a higher dividend (compared to the company's common stock) for a certain number of years and then get converted into common shares on a specified date. These securities have limited capital appreciation potential. In other words, the issuer puts a cap on the appreciation by specifying the conversion terms. Participating Equity Preferred Shares, a type of mandatory convertibles, is designed to provide investors with high current income with high equity-like participation in the underlying stock. PEPS usually provide a coupon is usually paid quarterly. These securities mature in 3–5 years, are typically listed, and are usually call protected for most of their life.

In 1988, Avon announced a dividend reduction and simultaneously offered to exchange one share of a new $2.00 PERCS (Preferred Equity Redemption Cumulative Stock) for each of up to 18 million of Avon's shares that would pay dividends at the former dividend rate on the common stock. The new preferred would pay cumulative quarterly dividends of 50 cents accrued from September 1, 1988 to September 1, 1991.[7] The preferred shares would be mandatorily redeemed on the expiry date.[8] The holders would receive one common share for every PERCS share if

[7] Avon was paying $ 1.0 on common when it announced the PERCS issue.

[8] The company also retained the option of redeeming the issue at any time before the expiry date according to a declining schedule. An issuer is likely to call the PERCS if the share price is above the call price. Since the issue is callable, there is a possibility that the investor may not receive even a single dividend payment. To offset any potential dividend loss, the call prices usually follow a declining schedule. That is, the nearest call price will be the highest, the second slightly lower, and so on. The difference between the call price and the purchase price (i.e., capital gain) determines the return to PERCS holders. The call price schedule is designed in such a way that the return to the investor is the same regardless of whether the issue is called or not.

the price of the stock was less than \$31.50 or \$31.50 worth of common stock per PERCS share if the common stock was above that price. As with any preferred stock, the dividend is cumulative but the company cannot pay dividends to shareholders if the preferred dividend is in arrears. Citicorp, Times Mirror, and several other companies have issued PERCS in the recent years.

A PERCS is like a covered call write. Covered call writing is being long an underlying instrument (say, stock) and being short a call on that instrument. The maximum profit potential is equal to the strike price of the option minus the price of the underlying instrument plus the call price. The short call limits the profit potential of the underlying asset but it buffers the long position from the losses by the amount of the premium received. The holders of PERCS enjoy higher dividends for a certain number of years (three, in case of Avon) and in return give up a call option.

$$\text{That is, } P_p = P + \mathrm{PV}[D_p - D_s] - \mathrm{Call}$$

Where $P_p =$ price of PERCS, D_p and D_s are dividend payments on the PERCS and common stock, respectively, P is the current market price of the share, and Call is the value of the call option on the company's stock expiring at the PERCS maturity. These products are depicted on a debt–equity continuum in Exhibit 17.10.

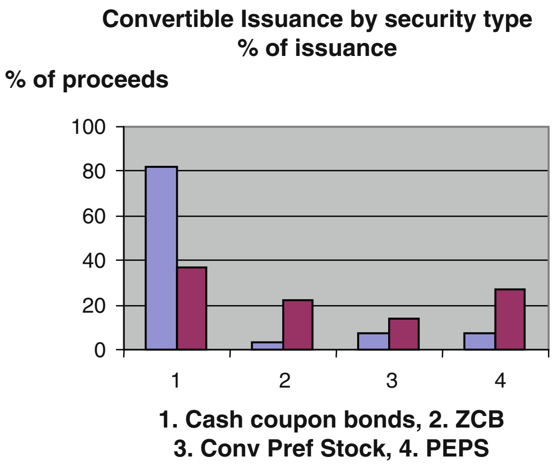
Exhibit 17.11 gives the break up of convertible issuance by security type.

Exhibit 17.10 Convertible product spectrum

Short Puts With high Premium	Zero Coupon	OID Bonds	Step-Up Coupon	Cash Coupon/ Exchangeable Bonds	Pref. Stock Trust Pref	PERCS	PEPS

Debt ⟵ ⟶ Equity

Exhibit 17.11 Convertible issuance by security type



17.8 Why Issue Convertibles?

Why do companies issue convertible bonds? Often convertibles are viewed as delayed equity. If the managers of a company expect the firm's stock price to rise and expect investors to exercise their option of conversion, a convertible, as opposed to an outright equity issue, will result in lower dilution. Since the investor has an option of conversion, the coupon on convertibles tends to lower than their non-convertible counterparts. For this reason, some managers consider convertibles "cheap." The coupon on convertibles is lower because of the valuable option (of conversion) given to the investor. The option of conversion is a sweetener attached to straight debt. The theoretical rationale for convertible is discussed below.

Agency Conflicts: Straight debt suffers from the moral hazard problem. That is, the company's risk can be shifted from equity to debt by taking on riskier projects. Since shareholders have limited liability, they enjoy all the upside potential but lose nothing in case of project failure. Smart bondholders realize this and demand higher coupon. The cost of moral hazard problem is borne by shareholders. Since holders of a convertible have a choice to convert debt into equity, the agency problem is reduced.

Risk Insensitivity: Suppose the managers and investors of a company disagree about the risk of a company. If investors believe that the company's risk is higher than that projected by managers, they will demand higher interest rates. The equity option in case of a convertible bond makes the value of the convertible insensitive to risk shifting. This is because the value of the straight bond component decreases as risk increases but the value of the equity component *increases*. Thus, the package as a whole is risk neutral. By issuing convertibles, the managers and investors come to an agreement so that the value of the instrument is insensitive to risk of a company. Convertibles are often issued by high growth, risky firms for this reason.

Information Asymmetry: At times, the managers of a company may have better information than outside investors about the company's prospects. If the market undervalues the company's shares, the managers of the company have a disincentive to issue equity. They may issue debt. But debt increases the probability of bankruptcy. Convertibles fall in between. On the basis of this analysis, we would expect convertibles to be issued by those companies that are undervalued but not to a large extent, straight debt by undervalued companies, and equity by overvalued companies.

High growth firms may not find straight debt attractive as they may not have an investment – grade rating. So the interest expense will be high. Defaulting on interest payments may lead to restrictions on investment activities of the firm, which curtails growth. Equity financing will be expensive as high growth firms may have to sell equity at lower prices than that implied by growth opportunities. Those managements that have confidence in the future of the company can issue convertibles and use the call provision to force conversion when the stock price rises in the future (Brennan and Schwartz 1988).

Situations where convertibles had been the only funding alternative are caused by three factors:

- Unfavorable market conditions: for example, the convertible market was the first market to reopen following the 1998 and 9/11 crises; or to support the equity portion through a combined deal.
- Company-specific conditions: for example, financial distress or as part of an overall restructuring program. For non-rated or sub-investment grade issuers, the equity-linked market often offers the "only" option to quickly raise funds at reasonable terms.
- Both: Deutsche Telekom's mandatory convertible bond for balance sheet strengthening. Market conditions in 2003 would only have absorbed a rights issue at a large discount. In most cases, however, convertibles are the preferred option, because they offer cheaper opportunistic funding, diversification, a volatility play, and strategic financing. They also offer increased capital market visibility for small- and mid-cap companies and for companies from developing capital markets.

17.9 Issuer Strategies After the Issue

Over time the stock price and hence the conversion premium change. Holding the convertible bond enables the investor to earn interest on the bond component while at the same time retaining the option of conversion if it is desirable. Given this advantage, an investor would prefer to hold the bond rather than convert it into shares. While an investor prefers to hold the convertible bond rather than convert because of the downside protection offered by the bond, the opposite is true for the corporation. Issuers would want to force conversion so that the legal obligation to pay interest and principal is replaced by the non-contractual, more flexible commitments (dividends) to common stock.

Issuers of convertibles face uncertainty in future capital structure of the company in the sense that the company receives equity only if investors convert the bond into shares. To make sure that the company receives shares if and when it is desirable, that is, to "control" investors, issuers can do two things:

- Insert a call option

Since the objective of management is to maximize the value of the stock (and not the value of convertible), the bond could be called as soon as the conversion value reaches the call price. The investor is coaxed to convert because he or she gets more by converting than by holding the bond. In short, the management places a lid on the value of the convertible. Usually, investors have 30 days to decide whether to surrender the bond or convert.

- Increase dividends making conversion more attractive

At the time of issue, the coupon on convertible is set higher than dividends on the shares (otherwise the investor will immediately convert). As long as the coupon is higher than dividends, the investor enjoys higher income simultaneously retaining the option. The issuer can induce investors to convert by raising dividends. When dividends are sufficiently high, bondholders voluntarily decide to convert. But conversion exposes the investor to the risk of common stock.

One of the prime assumptions in issuing convertibles is that the company's stock price will rise in future. If, for some reason, the stock price falls after issuing the convertible, investors will not convert and straight debt remains. This situation is called "debt over hang." Often managers cite the debt over hang problem for not issuing convertibles. If the company issues convertibles when the chief alternative is debt, one need not crib when investors do not convert because the interest rate on convertibles is lower than that on straight debt resulting in cash savings. In fact, an issuer should rejoice. But the over hang problem is not solved. One should fix the root cause of a problem, not its consequences. Managers are constantly under pressure to get the best immediate financing deal. This prompts them to take a short-term view. Companies implicitly hold valuable growth options. So a company's financing should be structured in such a way that financial flexibility to exercise its growth options in future is maintained. The financial plan should ensure future access to capital even if it means a higher price for capital today (Willigan 1989). Going by this reasoning, high growth, start up firms should choose between convertibles, straight bonds, and equity not just on the basis of current cost of capital and debt ratio but also on the basis of future financing needs and cost of capital. Even though convertibles ordinarily make sense to high growth firms, a company with high operating leverage, high (current) debt ratio, and uncertain product market conditions should issue equity even if it implies selling stock at a discount.

As pointed out above, when share price falls, conversion will become increasingly unlikely. When the price drop is substantial, the possibility of upside potential is remote and the instrument trades like a bond. Such converts, in the market parlance, are called busted convertibles. Likewise, when share price rises substantially, the instrument increasingly resembles equity.

17.10 Investor's Perspective

Probably the most frustrating aspect of a convertible is its call feature – often overlooked in its evaluation. If interest rates should decline significantly after the convertible bond is issued, most companies can and will call their bonds, in which case one loses the source of what had been a relatively attractive income, and must then reinvest the proceeds in another vehicle at the then lower rates of interest. On the other hand, if interest rates go up, there is no chance that the bond will be called, and so the investor is stuck with a lower-than-market rate of interest on the bonds. This is an example of a "heads, you lose; tails, you don't win" type of investment.

17.11 Valuation of Convertible Bonds (Nyborg 1996)

A convertible is a combination of debt and equity option. So, the value of a convertible is the sum of the straight debt and option components. The option embedded in a convertible is an American-type option, not European because the investor can convert any time up to maturity.

When pricing a convertible bond, analysts use a two-step process. First, compute the pure bond value of the convertible. This is equal to the net present value of the stated coupons and redemption value, using a series of discount rates equal to the spot rate plus credit spread for each fixed cash flow along the yield curve during the life of the convertible. For a new issue convertible, the pure bond value might equal, say, 85% of par. Subtract this 85% from par value of 100% to arrive at 15% par, which equals the convertible option premium. Analysts take this option premium and model it using a modified Black-Scholes framework to arrive at the implied volatility of the option embedded in the convertible. They also compute the sensitivities of the convertible with respect to stock, credit, interest rates, and implied volatility, also known as delta, omega, rho, and vega, respectively.

When analyzing a convertible, it helps to look across the capital structure of a company and compare bond, loan, and equity valuations. Convertible analysts evaluate the constituent factors that determine the overall risk/reward profile of each position and the portfolio as a whole. Mathematical modeling of convertibles requires assumptions about stock prices, credit spreads, yield curves, stock lending costs and common stock dividend yields, as well as accurate modeling of the terms and conditions of each convertible itself. The differentials between convertibles, loans, bonds, and equity may be considered in terms of fundamentals and valuation. Examining the fundamentals, analysts seek to understand the convertible's position in a company's creditor/debtor obligations since legal or structural subordination may confer higher default probability for a convertible than a loan or bond. With respect to valuation, one must consider the credit spreads of straight bonds, credit default swaps, and asset swaps to determine whether the default risk of a convertible is fairly priced relative to that of a comparable straight bond or loan.[9]

The Black-Scholes or Cox-Ross model takes into account the terms of the convertible, including its coupon, maturity, conversion ratio, call protection, and credit spread. The underlying stock's volatility and stock dividends are also taken into account. To find the value of the straight bond component one may use a single discount rate (equal to the yield on comparable bonds) for all the years or one may use the yield curve to calculate spot rates.[10] The pure bond value of the convertible is equal to the net present value of the stated coupons and redemption value, using a series of discount rates equal to the spot rate plus credit spread for each fixed cash flow along the yield curve during the life of the convertible. For a new issue convertible, the pure bond value might equal, say, 85% of par. This value can be subtracted

[9] Credit derivatives like credit default swaps are discussed in the chapter on credit derivatives.

[10] The yield curve is a plot of yields on bonds of a particular risk class against their tenor.

from par value of 100% to arrive at 15% par, which equals the convertible option premium. This option premium can be used to model it using a modified Black-Scholes framework to arrive at the implied volatility of the option embedded in the convertible. We can also compute the sensitivities of the convertible with respect to stock, credit, interest rates, and implied volatility, also known as delta, omega, rho, and vega, respectively. Convertible bond market professionals use the bond, loan, credit default swap, and asset swap markets to triangulate in on the correct credit spread assumptions for each convertible.

The Black-Scholes model modified to account for continuous dividends can handle a convertible bond without a call provision. The presence of the call provision makes valuation difficult. The value of the option (ignoring call and put provisions) can be estimated using the Black-Scholes formula.

$$\text{Value of Call} = Se^{(b-r)T}N(d_1) - Xe^{-rT}N(d_2)$$

Where
$S =$ stock price
$X =$ strike price or exercise price
$b =$ cost of carry defined as risk free rate minus the dividend yield (q)
$T =$ time to maturity in years
$\sigma^2 =$ variance in returns from the underlying stock

$$d_1 = \frac{\ln(S/X) + (b + \sigma^2/2)T}{\sigma\sqrt{T}}$$

$$d_2 = d_1 - \sigma\sqrt{T}$$

$X = \$\,1.98$
$S = \text{Rs.}\,59.24 = \$\,1.88$
$\sigma = 40\%$
$T = 5$ years
$r = 6\%$
$q = 5\%$
$e = 2.7183$

The option value can be estimated by plugging the inputs into the model. As mentioned earlier, the Black-Scholes model does not capture early exercise and call provision. The Cox-Ross model will not be discussed here because of its complexity. Interested readers may refer to Ingersoll (1977a,b), George Philips (1977), and Ho and Pfeffer (1996).

17.12 Convertible Bond Arbitrage[11]

The price of a convertible is sensitive to three major factors:

- Interest Rate: When interest rate goes up the price of the bond part tends to go down but the price of the call option part goes up. The net impact is that the price of the aggregate goes down.
- When the underlying stock price goes up, the convertible increases.
- Credit spread: If the creditworthiness of the issuer deteriorates resulting in a rating downgrade and its credit spread widens, the bond price goes down but in many cases, the call option value goes up because credit spread and volatility are correlated.

Given these complexities in the valuation of a convertible, a trader can make use of sophisticated quantitative models to identify bonds that are undervalued.

Convertible debt arbitrage involves buying a convertible and hedging two of the three factors to gain exposure to the third factor at an attractive price. For instance, a trader may buy a convertible bond then sell fixed income securities or interest rate futures (to hedge the interest rate exposure) and buy some credit protection (to hedge the risk of credit deterioration). The trader would be left with something similar to a call option on the underlying stock acquired at a cheaper price. He can then make money by selling more expensive call options traded in the open market or delta hedging his exposure to underlying shares.

17.13 Accounting for Convertibles: The Issuer's Perspective

Accountants in the US record convertible bonds entirely as debt. They, however, add the potential shares that would arise from conversion to total shares outstanding for computing fully diluted EPS. These treatments do not take into account the "optionality" involved in convertible bonds. Traditionally, convertible debt is accounted for on the "as-if-converted" method, as it is considered a stock equivalent. Consequently, the pro-forma EPS after the issue is the lower of

$$(1)\ \frac{\text{Net income} - \text{convertible coupon} + \text{after tax reinvestment income}}{\text{Total shares outstanding}}$$

$$(2)\ \frac{\text{Net income} + \text{after tax reinvestment income}}{\text{Total shares outstanding} + \text{common shares underlying convertible}}$$

[11] A good book on the subject is Calamos, Nick, Convertible Arbitrage: Insights and Techniques for successful hedging, John Wiley, 2003. Also see Connolly, Kevin, Pricing Convertible Bonds, John Wiley, 1998.

Exhibit 17.12 Accounting for convertibles

	Convert outstanding	Converted
Revenue	$100,000,000	$100,000,000
COGS & OPEX	65,000,000	65,000,000
EBIT	35,000,000	35,000,000
Interest Expense	2,000,000	–
Tax @ 3% rate	990,000	1,050,000
Net Income	32,010,000	33,950,000
Shares outstanding	100,000,000	116,000,000
EPS	$ 0.32 per share	$ 0.29 per share

Where after-tax reinvestment income is the income generated from proceeds raised and the total shares outstanding does not include shares underlying convertible. Exhibit 17.12 presents an illustrative example of "if converted" method. The example assumes $2 m annual interest payment and that 16 m shares are issuable upon conversion of the convertible note.

Convertibles are accounted for by companies on their balance sheets in a variety of ways:

- Liabilities section
- Equities section
- Mezzanine section

The location of the convertibles on a balance sheet depends on the type of security and the company's accounting policy. If the issue is recorded as debt, the issuance of new debt and retirement of previously outstanding debt is reflected in the Long-Term debt section of the balance sheet. The convertible issuance is reflected as a positive cash flow from financing on the statement of cash flows. Interest expense actually decreases, due partially to the lower coupon of the convertibles.

The fundamental financial instrument approach of the FASB proposes that a compound instrument, such as a convertible bond, can be understood as being made up of fundamental financial instruments. Two methods of accounting for a convertible bond are seen as consistent with this approach: (a) recognize the fundamental components of a convertible bond separately in the accounts; and (b) analyze a convertible bond in terms of its fundamental components and account for it as a single instrument. There is currently disagreement among accounting regulators as which of these methods should be used.

One approach is to discount the coupon and principal at a suitable rate and record this present value as debt and estimate the value of option using standard option pricing models like Black-Scholes and record this option value as equity (Arak and Ann 2005). The number of shares represented by the convertibles is calculated as this "equity value" divided by the current share price.

17.14 Warrants

A warrant is an option that gives the holder the privilege of buying a specified number of shares of the company at a specified exercise price at any time on or before the expiration date. Warrants usually come as attachments to bonds to make an issue more attractive to investors. The debenture holder can exercise a warrant. Warrants can also be detached and separately listed on a stock exchange for trading purposes. The issuer of the warrant receives the price of the warrant at the time of issue and the exercise price when the option is exercised. The company gets equity investment if the investor exercises the option. The uncertainty in the investor's reaction can affect further debt issuance by the company. In other words, if warrant holders do not exercise the option, the company may have to postpone further debt issuance due to inadequate equity base. A company contemplating on issuing equity to build equity may issue debentures with warrants instead of issuing straight equity if the shares are fully priced because issuing shares at a discount to the current market price will result in underpricing of *all* shares subsequently. The exercise price is determined by market conditions. A issue of warrant at a strike price lower than that expected by the company's management will not affect a growing company much in the sense that the value of foregone capital in present value terms will not be high.

A comparison between convertibles and warrants is in order.

- The conversion rights are inseparable in case of convertibles. Warrants are separable from the bond and are usually listed on stock exchanges for trading.
- A warrant gives additional cash to the issuer when the holder exercises the right. A convertible does not.
- When convertibles are converted into shares, the associated debt is not repaid unlike in the case of a debt-warrant package.

Convertibles frequently come with call provision. The issuer can force conversion when situation so demands. Warrant holders cannot be coaxed to exercise.[12] They may or may not exercise their option depending on what has happened to the underlying share price in the interim. The warrant holders will not exercise if share price does not go up. So there is an element of uncertainty regarding the amount of equity the issuer gets. If cheap debt is the objective regardless of what happens to equity, warrant with debt is a better choice.

Warrants are like exchange traded call options. But there are some differences:

- Call options are contracts between two individuals/entities whereas a warrant is a call option sold by the issuing company to the general investing public.
- When warrants are issued, the company receives the issue price.

[12] It is possible to design the package in such a way that the investor gets to exercise the warrant by turning in the bond. In other words, the package behaves like a synthetic convertible.

- When warrants are exercised, the company receives exercise price.
- When warrants are exercised, the company issues *new* shares.

In their simplest form warrants are call options. Their payoff resembles the payoff from a standard call option. But there is a difference. Assume that an all-equity company has S shares and W warrants outstanding. The warrants can be converted into r shares at an exercise price of X per share.

On the date of maturity, warrant holders will exercise if the value of shares they receive is more than the exercise price. Upon exercise, they will receive Wr new shares for which they pay WrX. Assume that the current market value of the company is V_0. After the exercise, the total number of shares increases to $\mathrm{S} + \mathrm{W}r$ and the firm value to $V_0 + \mathrm{W}rX$.

$$\text{The fraction of all shares owned by warrant holders} = \lambda = \frac{\mathrm{W}r}{\mathrm{S} + \mathrm{W}r}$$

λ is the dilution factor of warrants.

The value of shares received by warrant holders if they exercise $= \lambda(V_0 + \mathrm{W}rX)$
Total exercise price $= \mathrm{W}rX$
So, the net value at maturity is: Max $[\lambda(V_0 + \mathrm{W}rX) - \mathrm{W}rX, 0]$

The payoff of a warrant can be written as a function of the company's assets V_0 if warrants are not exercised. The graph of the payoff of a warrant looks exactly like that of a call option except that the slope is the value of dilution factor and not 1.

Some academics, however, argue that the dilution factor should not be taken into account because the behavior of stock price during the life of the warrant should already reflect the potential dilution (Crouhy and Dan 1991). Imposing an exogenous coefficient, therefore, results in double counting of the dilution effect.

Warrants are priced using standard option pricing model like the Black-Scholes model. But the model cannot be applied directly. For example, the model assumes constant volatility. This is problematic for a warrant with a life extending over several years. Further, issuing warrants reduces the volatility of equity, because part of the firm's volatility is incurred by the warrant holders. The standard deviation of stock returns would therefore be underestimated and biased. Similarly, if the exercise price of the warrant changes during its life, the option pricing method must be modified to take that change into account.

17.15 Concluding Comments

Given below is a summary of issuer purpose, advantages, investors' advantages and focus in investing in convertibles.

Issuer purpose	*Issuers' advantage*
Raise growth capital	Reduced interest cost
Restructure balance sheet	Issue stock at a premium
Restructure existing debt structure	Better manage capital
Obtain commercial paper equivalent	Minimum dilution
	Tax benefits
Investor focus	*Investors' advantages*
Growth oriented	Income pick up
Value focused	Upside participation as stock price rises
Fixed income investors	Downside protection if stock price declines
	Call protection

Just as one can use any of the stock market indices to benchmark performance in case of stocks and stock portfolios, one may use convertible bond indices for asset allocation and performance measurement in case of convertible bonds. Given below are some of the popular indices:

- Goldman Sachs/Bloomberg Convertible Indices
- Jefferies Convertible Bond Indices
- Merrill Lynch Convertible Bond Indices
- UBS Investment Bank Convertible Bond Indices
- Morgan Stanley Convertible Bond Indices

Appendix 1 provides a glossary of convertible bond terms.

Appendix 1: Glossary of Terms

Given below is a glossary of commonly used terms in the convertible bond market.

Bond Value: is the value of a convertible security without its conversion feature. The bond value establishes a lower theoretical bound to the price of a convertible issue. It is also referred to as investment value. Bond flows are discounted at the issuer's cost of debt.

Busted Convertible: A convertible in which the equity has substantially declined below conversion price and the convertible is trading on or near bond value, typically with a high conversion premium.

Call Price: The price at which the issuer has the right to redeem the bonds before maturity.

Call Protection: The period during which a convertible cannot be called for redemption by the issuer.

Conversion Premium: The amount by which the price of the convertible security exceeds the conversion value, expressed as a percentage.

Conversion Price: The equity price per share at which parity equals the par value of the bond.

Conversion Ratio: The number of common shares received upon conversion of a convertible security can be delivered by dividing the issue price by conversion price.

Conversion Value: The current market value of the total equity received upon conversion (equal to the product of the stock price and the conversion ratio).

Current Yield: The annual amount of the coupon as a percentage of the convertible security's current price.

Delta: The change in the convertible price for every point change in the price of the underlying security.

Gamma: The change in the convertible's delta due to changes in the price of the underlying security.

Kappa: The change in the convertible's price due to changes in the volatility of the underlying security.

Appendix 2: Terms of the NEC Trust Preferred Securities Issue

Outline of NEC Trust Preferred Securities

1.	Name of Issuer	NEC Business Trust (the "Trust")
2.	Name of Securities	NEC Trust Originated Preferred Securities: "TOPrS"
3.	Type of Securities	Preferred beneficial interests in registered form with liquidation preference of ¥ 500,000 per unit issued by the Trust established under the laws of the State of Delaware (foreign investment trust securities).
Number of Units	200,000	
5.	Aggregate Issue Price	¥ 100 billion
6.	Issue Price	¥ 500,000 per unit
7.	Distributions	Distributions will be payable on June 18, 2002 for the distribution period commencing on the issue date and ending on May 15, 2002, and thereafter on each December 18 and June 18 (each a "Payment Date"), for the semi-annual distribution periods ending on each November 15 and May 15, commencing June 18, 2001.
8.	Distribution Amount and Distribution Rate	Indicative pricing range as follows: (1) to (3)

(continued)

		(1) Distribution paid on initial Payment Date (June 18, 2002): ¥6,000 ~ ¥7,250 per unit 2) Distribution paid from the second Payment Date to the tenth Payment Date (December 18, 2006): Fixed rate of 2.40% ~ 2.90% per annum) (3) Distribution paid on the eleventh Payment Date (June 18, 2007) and thereafter: Floating rate of 6 month Yen Libor + 1.95% ~ 2.45% (estimated) per annum. The distribution rate will be determined on December 7, 2001 after pre-marketing at the above indicative pricing ranges.
Deferral and Accrual of Distributions	When interest payments of the Invested Debentures [as defined in (2) section 8] are deferred and the interest payment periods of the Invested Debentures are extended [as defined in (2) Terms of the Unsecured Subordinated Debentures due 2021, Section 7(2)], no payment of distributions will be made. Distributions not paid on the scheduled Payment Date will accumulate and interest thereon shall compound and accrue semi-annually at the rates in Item 8 above.	
10.	Condition for Payment of Distributions and Redemption Amounts	Distributions are payable only to the extent that payments of interests and/or redemption are made in respect of the Invested Debentures and to the extent the Trust has funds available there for.
11.	Invested Debentures	Subordinated Debentures and Replacement Subordinated

(continued)

		Debentures issued by NEC [please refer to (2) Terms of the Unsecured Subordinated Debentures due 2021, Section 7(1)].
12.	Redemption Price	¥500,000 per liquidation preference of ¥500,000.
13.	Maturity	Perpetual; provided that if the Invested Debentures are redeemed, the TOPrS will be mandatorily redeemed in whole at an amount equal to the Liquidation Preference plus accumulated and unpaid distributions thereon (if any).
Subscription Period	From December 10, 2001 to December 14, 2001	
15.	Date of Payment	December 18, 2001
16.	Pledge/Guarantee	NEC will guarantee payments to the extent described in (3) below
17.	Underwriters	Merrill Lynch Japan Securities Co., Ltd., Daiwa Securities SMBC Co., Ltd., and Shinko Securities Co., Ltd.
18.	Listing	Tokyo Stock Exchange, Inc.
19.	Places of Subscription	Branches and sales outlets of Merrill Lynch Japan Securities Co., Ltd., Daiwa Securities Co., Ltd., Daiwa Securities SMBC Co., Ltd., and Shinko Securities Co., Ltd.
20.	Credit Ratings	A- (expected) by Rating and Investment Information, Inc. Baa2 (expected) (under review for possible downgrade) by Moody's Investors Service, Inc.
21.	The domestic public offering of the TOPrS will be made only upon the declaration of effectiveness of the Securities Registration Statement under the Securities and Exchange Law of Japan	

Terms of NEC Unsecured Subordinated Debentures due 2021 ("Subordinated Debentures")

1.	Name of Debentures	NEC Unsecured Subordinated Debentures due 2021.
2.	Aggregate Principal Amount	¥100,001 million.
3.	Coupon	Indicative pricing range as follows: (1) First Coupon Payment Date to Tenth Coupon Payment Date Fixed rate of 2.40%∼2.90% per annum (2) Eleventh Coupon Payment Date and thereafter Floating rate of 6 month Yen Libor+1.95% ∼ 2.45% (estimated) per annum.
4.	Interest Payment	Interest shall be paid from the Issue Date up to but not including the Redemption Date, commencing June 18, 2002 for the period from issuance to the day preceding such payment date, and thereafter semi-annually on December 18 and June 18 of each year (each such date, an "Interest Payment Date") for the 6 month period ending on the preceding day.
5.	Issue Price	¥485,000 per denomination of 500,000.
6.	Redemption Price	¥500,000 per denomination of ¥500,000.
7.	Redemption Terms	(1) Redemption at Maturity: December 18, 2021 (Upon such maturity, NEC has the right to reissue subordinated debentures with substantially the same terms and with Floating Rate coupons as indicated in 3 Item 2 above ("Replacement Subordinated Debentures"). (2) Optional Redemption: On each Interest Payment Date beginning on December 18, 2006, NEC shall have the right to redeem the Subordinated Debentures, in whole but not in part, at a redemption price equal to 100% of the principal amount of the Subordinated Debentures plus accrued but unpaid interest, including compounded interest, if any, to the Redemption Date. (3) Special Event Redemption (Tax, etc.): NEC shall have the right to redeem the Subordinated Debentures at any time in whole but not in part, at a redemption price equal to 100% of the principal amount of the Subordinated Debentures plus accrued but unpaid interest, including compounded interest, if any, upon any change in Japanese tax which may require NEC to pay specified additional amounts, or upon certain other tax, accounting or regulatory events.

(continued)

8.	Special Features	(1) Subordination: If NEC shall become subject to bankruptcy, liquidation, corporate reorganization, civil rehabilitation, or other equivalent proceedings (“Subordination Event”), payments on the Subordinated Debentures will rank junior to all other indebtedness of NEC and will be made only after all such other indebtedness is paid. If liquidation proceedings are commenced in respect to NEC, holders of the Subordinated Debentures will have rights for proportionate liquidation distributions with the most senior directly issued preferred or preference stock, if any. Holders of the Subordinated Debentures will have rights senior to holders of NEC’s capital stock other than preference shares. (2) Interest Payment Deferral: NEC shall have the right at any time, from time to time, to extend the interest payment period of the Debentures for a period not exceeding ten consecutive semi-annual periods (5 years) from the date of issue or the most recent date that interest has been paid or been duly provided for. Deferred interest will accumulate and be compounded on a semi-annual basis at the rate specified in 3 above. If, with respect to any fiscal year, NEC pays dividends on any capital stock or, in any fiscal year, NEC purchases or acquires its capital stock in certain transactions, NEC shall pay all interest (including compounded interest, if any) due on the Subordinated Debentures on the Interest Payment Date in December immediately following the end of such fiscal year, and on the subsequent Interest Payment transactions shall not include those related to stock option programs, purchases of shares of capital stock prescribed by Japanese law, and certain other transactions. (3) Events of Default: If there occurs a default in payment of any interest or other amount due under the Debentures [subject to (2) above], or a default in the observance or performance of any covenant or agreement of NEC or any misrepresentation of NEC made in the Debentures that has a material adverse effect on

(continued)

		the holders of the Debentures, or upon the occurrence of a Subordination Event, holders may declare the Subordinated Debentures to be immediately due and payable.
Issue Date	December 18, 2001	
10.	Pledge/Guarantee	There is neither guarantee nor pledge for the Subordinated Debentures.

(3) Terms of the Trust Preferred Securities Guarantee

1. NEC will guarantee the payment of the distributions on the Trust Preferred Securities and payments on the liquidation of the Trust or redemption of the Preferred Securities, but only to the extent that the Trust has funds available from the receipt of interest and redemption amounts on the Subordinated Debentures.
2. Upon the occurrence of a Subordination Event, NEC's obligations under Item 1 above will rank junior to all other indebtedness of NEC and will be performed only after all such other indebtedness is paid. If liquidation proceedings are commenced in respect to NEC, holders of the Guarantee will have rights for proportionate liquidation distributions with the most senior directly issued preferred or preference stock, if any. Holders of the Guarantee will have rights senior to holders of NEC's capital stock other than preference shares.
3. No pledge.

(4) Trust Common Securities.

NEC will acquire 2 units (total of 1 million) of the Trust Common Securities issued by the Trust.

Appendix 3: Terms of the NEC Zero Coupon Convertible Bonds Due 2000

Outline of Terms of the Zero Coupon Convertible Bonds due 2010

1.	Name of the Bonds	NEC Corporation Zero Coupon Convertible Bonds due 2010 (the "Bonds")
2.	Total Issue Amount	JPY 100 billion
3.	Issue Price	Undetermined (to be determined at the board meeting)
4.	Denomination	JPY 5,000,000
5.	Form of the Bonds	Bearer Bonds
6.	Coupon	No interest is borne on the Bonds.
7.	Signing Date	To be determined between November 16, 2001 and November 22, 2001 (otherwise stated, all dates are based on London time)

(continued)

8.	Payment and Issue Date	December 10, 2001
9.	Final Maturity Date	Redeemed on March 31, 2010 at 100% of the nominal amount of each bond.
10.	Early Redemption by 130% Call Option Clause	On and after December 10, 2004, NEC may, having given not less than 30 nor more than 60 days' notice to the Bondholders, redeem all, but not some only, of the Bonds then outstanding at their principal amount, provided, however, that no such redemption may be made unless the closing price of NEC shares at the Tokyo Stock Exchange for each of the 20 consecutive trading days, the last of which occurs not more than 30 days prior to the date upon which the notice of such redemption is first published, is at least 130% of the conversion price in effect on each such trading day.
11.	Early Redemption in Case that NEC Becomes a Wholly Owned Subsidiary of Another Company	If NEC resolves at its general meeting of shareholders to become a wholly owned subsidiary of another company by way of kabushiki-kokan or kabushiki-iten, NEC may, having given not less than 30 nor more than 60 days' notice to the Bondholders and prior to the effective date of such kabushiki-kokan or kabushiki-iten, as the case may be, redeem all, but not some only, of the Bonds then outstanding at the following redemption prices: From December 11, 2001 to March 31, 2002 108% From April 1, 2002 to March 31, 2003 107% From April 1, 2003 to March 31, 2004 106% From April 1, 2004 to March 31, 2005 105% From April 1, 2005 to March 31, 2006 104% From April 1, 2006 to March 31, 2007 103% From April 1, 2007 to March 31, 2008 102% From April 1, 2008 to March 31, 2009 101% From April 1, 2009 to March 30, 2010 100%
12.	Issue Place	City of London, United Kingdom
13.	Subscription Method	Daiwa Securities SMBC Europe Limited and Morgan Stanley & Co. International Limited together with other managers have agreed to jointly and severally subscribe for the Bonds, which will be offered in overseas markets mainly in Europe (excluding the United States of America)
14.	Listing	Application has been made to list the Bonds on the Luxembourg Stock Exchange
15.	Initial Conversion Price	Undetermined (to be determined at the board meeting to be held in the near future)

(continued)

16.	Adjustment to Conversion Price	The conversion shall be adjusted by the following formula in case, after the issuance of the Bonds, NEC issues new shares at less than the current market price of NEC shares.

$$\text{Adjustment Conversion price shares} = \text{Conversion price prior to adjustment} \times \frac{\text{No. of outstanding shares} + \text{No. of newly issued shares} \times \text{price of newly issued shares}}{\text{No. of outstanding shares} + \text{No. of newly issued}}$$

		The Conversion price will be subject to adjustment upon split or consolidation of NEC shares, and in case of issuance of any securities with rights to subscribe for new shares of NEC, or with initial conversion price at less than the current market price of NEC shares.
17.	Shares Issued Upon Conversion	Ordinary shares of NEC
18.	Conversion Period	On and after January 7, 2002 up to, and including the business hour on March 17, 2010.
19.	Amount Conversion Price which shall not be accounted for as stated capital	Conversion Price determined in Item 15 above (if adjusted under Item 16, then the adjusted conversion price is applicable), less the amount of paid-in capital. Amount of paid-in capital is determined by multiplying 0.5 to the initial or the adjusted conversion price, with fractions rounded up.
20.	Collateral or Guarantees	There is no collateral, guarantees, or reserved assets for the Bonds.
21.	Rating	The Bonds are rated A+ by Rating and Investment Information, Inc. and Baa1 (under review for possible downgrade) by Moody's Investors Service, Inc.

(Reference Information Regarding the Bonds)

1. Use of proceeds of the Bonds

(1) Use of proceeds of the Bonds
While net proceeds is dependent of the issue price of the Bonds, we intend to use JPY 20 billion for capital expenditure program, JPY 30 billion for strategic investments, and the rest as part of capital required for implementation of our business strategy, which includes structural reform of semiconductor business.

(2) Changes to the use of proceeds of the previous fund raising
With refer to the net proceeds (JPY 97.7 billion) of the convertible bonds issued on 11 August, 2000, NEC has made changes to the initially planned use of proceeds such that JPY 77.7 billion for strategic investments was reduced by JPY 56.0 billion to JPY 21.7 billion and the JPY 56.0 billion was added in contrary to JPY 20 billion reserved for investments on plants and equipment, due to the continued downturns in the IT business environment.

(3) Effect on NEC's income
Along with investments towards IT business where high growth is expected, NEC intends to implement substantial structural reform on electron devices business in order to improve income base in mid-terms.

2. Distribution of profits among shareholders, etc.

(1) Basic principles on distribution of profits
Distribution is determined with consideration of required capital by assessment of state of income of each year, forecast of year onwards, payout ratio, investments on equipment, etc. in order to implement continuous structural reform to cope with drastic movements in economic conditions.

(2) Views on determination of dividends
In accordance with the above principles, NEC paid JPY 11 per share (including interim dividend of JPY 5.5 per share) as dividend for the year ending March 2001. However, as announced on October 26, 2001, NEC is expecting dividend of JPY 6 per share (including interim dividend of JPY 3 per share) for the year ending March 2002.

(3) Use of internal reserves
Internal reserves for the year ending March 2002 will be used towards R&D and capital expenditure program that would contribute our business development.

(4) Dividends paid for the past 3 financial years

	March 1999	March 2000	March 2001
Net profit per share	JPY (87.63)	JPY 14.02	JPY 14.45
Dividend per share	JPY 8.50	JPY 6.00	JPY 11.00
Payout ratio	–	42.8%	76.4%
ROE*	(14.2%)	2.4%	2.4%
Dividend/ Shareholders' Equity**	1.5%	1.0%	1.7%

*ROE for each financial year is determined by division of net profit by shareholders' equity (average of start and year end shareholders' equity of the applicable year) of applicable year.

**Ratio of dividends/shareholders' equity for each financial year is determined by division of total annual dividend by shareholders' equity (year end shareholders' equity) of applicable year.

(5) Distribution rules for income in the past
Inapplicable.

3. Others

(1) Directions on allocation
Inapplicable.

(2) Information on dilution effect from the underlying shares
Undetermined (dependent on conversion price)

(3) Information on previous equity fund raising
1. Equity financing within past 3 years
   #11 Unsecured Convertible Bonds
   E-Total Issue Amount JPY 100 billion
   E-Issue Date August 11, 2000
   E-Conversion Price JPY 3,207
2. Share price movements of the past 3 financial years (unit: JPY)

	March 1999	March 2000	March 2001	March 2002*
Start	1,340	1,406	3,030	1,998
High	1,492	3,190	3,450	2,390
Low	762	1,250	1,520	900
Close	1,425	3,030	1,998	1,170

*Share prices are as of November 14, 2001 for the year ending March 2002.

3. PER and ROE of the past 3 financial years

	March 1999	March 2000	March 2001
PER	(16.26)X	216.10X	138.27X
ROE	(14.2%)	2.4%	2.4%

*PER for each financial year is determined by division of year end closing share price by per share net income of applicable year.
**ROE for each financial year is determined by division of net income by shareholders' equity (average of start and year end shareholders' equity of the applicable year) of applicable year.

(4) Others
Inapplicable

17.16 End of the Chapter Exercises

1. Explain the following terms:
   - Conversion ratio
   - Conversion premium
   - Conversion value
   - Current yield
   - Busted convertible
   - Delta
   - Gamma
   - Kappa

2. How are convertible bonds different from exchangeable bonds?
3. What are the determinants of the value of a convertible bond?
4. What are credit sensitive and equity sensitive convertibles?
5. Who issues and who invests in convertibles?
6. Explain the rationale for convertibles.
7. What are Trust Preferred securities?
8. How are convertibles accounted for in the books of the issuer? Explain.
9. Describe how the Black-Scholes model is used for convertibles valuation.

References

Arak M, Ann M (2005) Convertible bonds: how much equity, how much debt? Financial Anal J March/April

Black F, Derman E, Toy W (1990) A one-factor model of interest rates and its application to treasury bond options. Financial Anal J Jan – Feb

Black F, Scholes M (1974) From theory to a new financial product. J Finance May

Brennan MJ, Schwartz E (1977) Convertible bonds: valuation and optimal strategies for calls and conversion. J Finance Dec

Brennan M, Schwartz E (1988) The case for convertibles. J Appl Corp Finance 1(2) Spring

Brigham E (1966) An analysis of convertible debentures: theory and some empirical evidence. J Finance 21

Casson P (1998) A re-examination of the case for accounting separately for the debt and equity features of convertible debt. J Busin Finance Acc June–July

Chacko G, Strick EP (2002) Convertible securities. HBS case No 9–202–129, June 28

Crouhy M, Dan G (1991) Common errors in the valuation of warrants and options on firms with warrants. Financial Anal J Sep–Oct

Ganshaw T, Dillon D (2000) Convertible securities: A toolbox of flexible financial instruments for corporate issuers. J Appl Corp Finance 13(1) Spring

Jen FC, Choi D, Seong – Hyo L (1997) Some new evidence on why companies use convertible bonds. J Appl Corp Finance 10(1) Spring

Ho TSY, Pfeffer DM (1996) Convertible bonds: model, value attribution, and analytics. Financial Anal J Sep–Oct

Narayanan MP, Lim S (1989) On the call provision in corporate zero –coupon bonds. J Financial Quant Anal 24

Nyborg KG (1996) The use and pricing of convertible bonds. Appl Math Finance 3

Philips G (1997) Convertible bond markets. MacMillan, London

Sidenius J (1996) Warrant pricing- is dilution a delusion? Financial Anal J Sep–Oct

Stein J (1992) Convertible bonds as back door equity financing. J Financial Econ 32

Willigan G (1989) The case of the expensive expansion. Harvard Business Rev, Jan–Feb

Chapter 18
Managing Fixed Income Portfolios

Chandrasekhar Krishnamurti

18.1 Chapter Introduction and Objectives

As pointed out in the chapter on fixed income securities, the market for debt instruments is large and growing. Active players in the market include mutual funds, pension funds, banks, and financial institutions. In this chapter we provide an overview of strategies for managing fixed income portfolios. The subject is inherently complex and quantitative. Consequently, we have left out the details to specialized books on fixed income portfolio management. Readers may refer to the references provided at the end of the chapter.

18.2 Introduction

At the most basic level, managing a fixed income portfolio consists of making a forecast of the yield curve and deciding which instruments will best take advantage of those forecasts. The key relationship is between interest rates and prices; a change in the yield curve will have an unequal impact on the prices of different bonds. In addition, though, yield curve changes have an impact on credit spreads (as credit spreads and yield curve changes are both affected by the business cycle) and the relationship between interest rates and credit spreads needs to be considered. Unlike equities, for instance, fixed income instruments are typically traded over the counter. This implies that liquidity and pricing are concerns for traders. The universe of instruments available to the fixed income manager has greatly expanded, with a variety of synthetic structures now available. As a result, portfolio managers now have sharper tools for managing portfolio risks and for maximizing returns given risk.

C. Krishnamurti
Mail Number B-3, Business School, AUT University, Private Bag 92006, Auckland 1142, New Zealand
e-mail: Chandrasekhar.krishnamurti@aut.ac.nz

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_18,

In this chapter, we consider the following aspects of fixed income portfolio management:

1. Passive management
2. Active management: money market funds (MMFs)
3. Active management: treasury funds
4. Active management: credit risk approaches
5. Active management: multicurrency approaches
6. Performance measurement

18.3 Passive Management

Passive management of portfolios is appropriate when

(a) Asset allocation is considered to be a bigger driver of long-term returns than choosing specific investments within asset classes and/or
(b) Markets are assumed to price investments correctly, so that there are no additional returns (net of transaction costs and management fees) to "picking" specific investments.

In either instance, passive management consists of buying a portfolio of securities that matches some predefined criteria and trading securities only if over time the portfolio ceases to match those characteristics. Typically, passive portfolios have a much lower portfolio turnover, implying smaller brokerage and transactions costs which, in turn, impact returns positively. Since passive management does not imply any special security picking skill on the manager's part, management fees are also very low, again impacting returns positively.

The key to passive management is to define the criteria which the portfolio is to match. In the fixed income arena, these would typically be the returns and risks of portfolios of treasury securities. The benchmark portfolios would differ in their average maturity/duration. For instance, a portfolio could include treasury bills with maturities from 0 to 6 months. This portfolio would have a duration and maturity of $\sim$3 months and would be a proxy for the lowest risk fixed income portfolios. At the other extreme, a portfolio could include treasury bonds with 15 years or more to maturity. The average maturity of this portfolio would be in excess of 20 years. The price risks (measured by, e.g., the standard deviation of monthly returns) would be much higher than the 3 month T-Bill portfolio. This portfolio might be an appropriate benchmark for an asset allocation scheme which invests a certain proportion of its assets in longer maturity bonds, or a fixed income mutual fund whose range of permissible instruments includes bonds with long maturities. There are several advantages to constructing treasury-based benchmark portfolios. First, these are the most actively traded fixed income instruments. Prices are readily available and intra day prices at specified intervals will typically be available as well. These prices represent actual transactions and thus fully reflect market activity and sentiment. Second, these instruments represent pure interest rate risks. As liabilities of the US government, default risks are absent. These benchmarks, therefore, represent pure interest rate “plays.” Third, as we will discuss in a later section, valuing fixed income portfolios with corporate debt is often a problem as prices are not readily available. A benchmark that includes corporate debt will typically have this shortcoming. Fourth, the characteristics of any benchmark that includes corporate debt will depend on the specific basket of securities included and the weights assigned to specific securities. Consider, for example, a portfolio which is to serve as a benchmark for AAA corporate debt with given duration characteristics. Since these securities have credit risk (a positive default probability), they trade at yields which are higher than equivalent treasuries. The credit rating, though, is not a very good proxy for the yield differential with treasuries. Issues with the same rating can and do trade at different spreads. One issuer could have more debt outstanding. Money managers typically have limits on exposure to specific issuers and might be unable to purchase additional amounts of the security, implying lower prices and higher yields. The market could value debt from different industries differently, again implying different spreads for different issuers. The liquidity and tradeability of specific issues could differ, implying that the yield spreads as well as the bid-offer spreads could vary across issuers. Finally, there has been a huge increase in the issuance of structured securities. Again, depending on the specifics of the structuring and the details of the credit enhancements of individual issues, credit spreads could vary across issues with nominally similar ratings.

These factors taken together imply that the characteristics and returns of any benchmark portfolio will be determined by the composition of the portfolio. There are a number of ways of choosing the composition of this portfolio: by the bonds outstanding, by liquidity, by industry weight, etc. Each is arbitrary in its way and unlikely to match a live portfolio unless that portfolio was explicitly set up to match it.

The passive manager’s job is threefold. First, he is expected to match or exceed the returns from the benchmark while matching the risk characteristics of the benchmark portfolio. Second, he is expected to keep expenses (brokerage and transactions fees) to a minimum. Third, he is not expected to change his portfolio’s characteristics in anticipation of changes expected in the market (hence, the term “passive”). The last, in turn, implies that management fees are expected to be very low, since no special portfolio management expertise is called for.

A passive manager typically tries to match or exceed the returns from the benchmark portfolio while matching that portfolio’s characteristics. The easiest way to do this is to purchase all the securities in that portfolio with the same weights. This would typically mean a portfolio with a large number of holdings with possible fractional or nonmarket lot holdings of specific securities. A more typical approach would be to run an optimization where the weights for individual holdings are chosen such that the returns of the portfolio are maximized subject to the cost of the portfolio being less than/equal to the amount to be invested and the weighted standard deviation less than/equal to that of the benchmark portfolio. The choice set for the optimization could be bonds with a minimum credit rating, specified quantities outstanding/trading volumes, and a given range of maturities. Historical returns and standard deviation data would need to be used, and the optimization would clearly have a look-back bias. Selecting the choice set carefully would, however, help ensure that any changes (in the bond characteristics) would affect both the benchmark portfolio and the choice set similarly. The optimization could be either a linear program or an integer program, and the variables would be the amount invested in each bond. The choice set would need to include cash/cash equivalents as one of the bonds. This approach would allow the choice of corporate bonds to exceed benchmark returns while controlling risks.

An alternative approach would seek to minimize the tracking error relative to the benchmark portfolio. The motivation for this approach arises from the value some performance analysts place on closely tracking the returns of the reference portfolio. In addition, if the returns track closely, so do the risks. This approach is fairly common with equity portfolios and is seen in fixed income portfolios as well. The optimization here would be to choose weights for portfolio holdings that minimize the difference between the portfolio and reference portfolio returns, with the constraint that the cost of the portfolio being less than/equal to the amount to be invested and the weighted standard deviation less than/equal to that of the benchmark portfolio. A key element here is the proportion of cash held in the portfolio. Any open-ended mutual fund would need to keep aside a redemption reserve; this is typically in cash or cash equivalents (short maturity liquid securities). For a fund with a longer duration, this could lead to tracking errors. There is, therefore, a tradeoff between close tracking and the need for the redemption reserve. The size of the reserve is a decision the portfolio manager needs to make based on his/her assessment of redemptions from the fund. Factors affecting redemptions could include seasonal elements (such as tax payment dates), the shareholding pattern of the fund (institutional vs individual), daily patterns (end of the month, pay days), recent returns for different asset/mutual fund classes, and so on. Funds that are legally able to do so may keep their redemption reserve as shares in a money market mutual fund.

18.4 Active Management: Money Market Funds

Money market instruments refer to fixed income instruments with a maturity of a year or less. MMFs invest exclusively in these instruments and are often used as substitutes for banking accounts. The key features of MMFs that allow this are liquidity and capital preservation.

Balances in bank accounts can be withdrawn at any time and MMFs need to provide the same facility. They usually do this by holding instruments with high liquidity, by maintaining a redemption reserve, and by diversifying across maturities (in order to have maturities coincide with anticipated redemptions). Capital preservation implies that MMFs are sold and redeemed at par. This is possible because the value of short maturity instruments does not vary much from their book value even for large interest rate changes. This means that they can be valued at book value without creating any adverse incentives (if interest rates rise, the market value of a bond will be less than the book value. If the Net Asset Value (NAV) of the portfolio is based on book value, any withdrawals will destroy value for those who continue with their portfolio holdings. Withdrawals will occur when the stated NAV exceeds the true value of a portfolio share, that is, when interest rates rise or when credit spreads widen). Valuing all holdings at the book value in turn implies that the NAV can be maintained at par. In order to ensure that the book value of holdings stay close to their true market value, the durations of all portfolio holdings need to be very short. A typical MMF will have an average portfolio maturity of a month or less (the duration would also be very close or identical to the maturity, given the short maturity and the fact that most eligible instruments in this range are discount instruments) and a maximum maturity for an individual instrument of a year.

The main investment decision for an MMF manager is to find ways of enhancing yields on instruments bought. Valuing holdings at book value implies that yields and returns are directly related. There is normally a trade-off between quality and liquidity and the portfolio manager needs to maintain a balance between the two keeping in mind the likely pattern of withdrawals. Further, given a "normal" (upward sloping) yield curve, a manager seeking to enhance yields will want to increase maturity. Again, a trade-off with the need to maintain NAV at par exists.

18.5 Active Management: Treasury Funds

Treasury funds invest exclusively in treasury securities. The maximum maturity/duration or the average maturity/duration might be restricted as a means of providing alternative risk-return trade-offs to investors. Restricting portfolios this way also helps in planning asset allocation strategies. Within these restrictions, the portfolio manager seeks to maximize returns. In effect, this means using either a formal model or a gut feel to predict future bond prices.

Bonds fall into three broad categories:

1. Sovereign debt issued in the local currency.
2. Bonds issued by entities other than governments and government debt issued in nonlocal currencies.
3. Structured products.

Bonds in the first category have zero default risk. Changes in their prices are due entirely to changes in the yield curve. This section looks at possible trading strategies for these bonds.

There are a number of models that attempt to relate the yield curve to future interest rate changes. The expectations hypothesis suggests that the forward rates constructed from the yield curve are estimates of future spot rates. Since the calculated forward rates depend on the steepness of the yield curve, the shape of the yield curve indicates the maturities where interest rate changes are expected to be highest, and this, in turn, suggests the best trading strategy.

Empirical tests of the expectations hypothesis have generally failed to support it. Alternatives such as the market segmentation hypothesis and the liquidity preference hypothesis modify the expectations hypothesis by arguing that bonds with different maturities have distinct markets. In other words, an investor who buys a 20-year bond is different (i.e., has a distinct reason for choosing a particular maturity range) from one who buys a 2-year bond. For example, life insurance companies might be natural buyers of long bonds, given their liability structure, but corporate treasuries or university endowments might not. These modifications of the basic expectations hypothesis are difficult to test, but a fund manager might well conclude, based on his/her assessment of these segmentation effects, that he/she can take advantage of relative mispricing of bonds with different maturities.

The notion that forward rates have information has been empirically tested by Fama (1976). He finds that forward rates are good estimates of holding period returns. This suggests a trading strategy that involves buying where the yield curve is steepest and rolling down the curve. The forward rates would be an unbiased estimate of the expected returns from this strategy. This strategy should outperform a buy and hold strategy with similar risk levels.

The trading strategies suggested thus far all ignore liquidity effects. Thus, while treasuries with similar maturities/durations are fungible, treasuries which are on-the-run trade at lower yields than others are more liquid. The strategy described in the preceding paragraph would suggest buying off-the-run treasuries with the highest yields, and the expected returns would need to be adjusted for the fact that the yields at the time of sale would also be higher than those of more liquid bonds. Likewise, any strategy involving the use of yield curve information should take the effects of liquidity on quoted yields and the bid ask spreads into account.

An alternate set of trading strategies compares actual bond prices to a theoretical ideal and looks to buy bonds which are cheap and (assuming the fund is allowed to) short bonds which are overpriced. The key here is to have a model for the yield curve.

Several approaches have been suggested for modeling yield curves. These are briefly outlined below. More detailed treatments can be found in references.

18.5.1 Statistical Curve Fitting Methods

1. Algebraic equations called splines are used to construct yield curves that minimize the pricing errors at different maturities. Splines are functions where the functional forms are either exponential or polynomial. Essentially, the yield curve is broken into a number of segments, each of which is estimated as an exponential or polynomial function. The estimation is done to minimize pricing errors (for actual treasury bonds/notes) while ensuring that the fitted curve is smooth and continuous.
2. The Nelson-Siegel (N-S) and Nelson-Siegel–Svensson (NSS) procedures posit an equation whose parameters allow the yield curve to take a variety of shapes.

The NSS curve allows for the yield curve to be "humped." The parameters of the equation are estimated to minimize pricing errors for actual treasury bonds and define the shape and slope of the estimated yield curve and have the added advantage of being interpretable as implied forward rates.

These statistical methods are exercises in data fitting; they do not have any underlying model explaining how interest rates change. Thus, while these methods might result in a well fitting yield curve from day to day, they cannot be used to predict future yield curves. This is as the estimated parameters often change significantly from day to day. These methods also often trade off pricing errors for smoothness. In other words, the estimated yield curve that minimizes pricing errors might also be one which lacks smoothness, implying significant differences in yields between bonds with similar maturities.

18.5.2 Yield Curve Fitting Using Models of Interest Rate Changes

A yield curve can be constructed using a short-term interest rate and a long-term interest rate. A number of influential papers (references) have attempted to model interest rate changes while constraining them to reflect the price behavior of bonds.

- Pull to par as bonds approach maturity
- Interest rates have to be positive

Some of these models also incorporate mean reversion of interest rates. Without this assumption, the interest rate process could result in outcomes with extremely high interest rates. These outcomes have not been observed in empirical studies; models with reversion to a single mean or which revert to outcomes around a central value better approximate reality.

The model described by Cox et al. (1985) models changes in short-term interest rates and incorporates mean reversion, positive interest rates as well as the assumption that the volatility of interest rate changes is proportional to the level of interest rates. The model can yield a variety of yield curve shapes. Several attempts (references) have been made to empirically test the Cox–Ingersoll–Ross (CIR) model. Given that it is a single factor (short rates) model, it does well on short term (T-Bill rates) but poorly on longer rates.

Attempts have been made to overcome this shortcoming by adding some free parameters which would result in a better fit with market data. In these models, the parameters are calibrated using market data. Examples of these models include those by Ho and Lee (1986), Black et al. (1990), Heath et al. (1987), and Hull and White (1994, 1996).

In practice, the statistical methods better fit market data. The resulting yield curves can be used to price specific cash flows including coupon-bearing bonds. They can also be used to determine whether specific bonds are rich or cheap relative to the estimated yield curve. Trading based on this sort of rich–cheap analysis should be tempered by the trader's perception of specific instruments and knowledge of the impact of liquidity factors on price. It should be noted that these estimated yield curves do not include liquidity effects and could thus be misleading if used for sell–buy decisions without further adjustments. It should also be noted that curves estimated thus cannot be used to forecast interest rates.

18.6 Active Management: Credit Risk Approaches

Any investment strategy that allows the purchase of nontreasuries involves decisions concerning credit risk. Liquidity considerations are also keys for these strategies. Episodes such as the long-term capital management (LTCM) collapse, the default by the Russian government and the recent subprime crisis have several implications for a fund manager.

- Liquidity can dry up without warning. "Normal" levels of liquidity are taken for granted when buying corporate bonds or collateralized debt obligations (CDOs). When extreme events occur, a "flight-to-quality" occurs and liquidity can dry up very quickly even for nominally high-rated bonds.
- The lack of a secondary market, in turn, implies that any pricing model for corporate debt/CDOs is unlikely to match market prices.

The compensation for credit risk is tied into secondary market liquidity. This implies that liquidity affects not only transactions costs but also the pricing of corporate debt and CDOs.

When purchasing nontreasury debt, the portfolio manager's decisions need to take both the levels and future direction of spreads over equivalent treasuries into consideration. Thus, the purchase/sale decision involves an assessment of interest rate risks, credit risks, as well as liquidity risks. The interrelationships between these risks need to be considered as well.

In considering credit risk and the market price for credit risk (which is reflected in the spreads over equivalent treasuries), it is important to note that a bond's rating is not always related to its yield in the secondary market. There are several reasons for this.

- Industry factors. The market might price industry-specific risks into bonds, which could result in interindustry yield differences.
- Types of bonds. Synthetic and asset-backed bonds typically trade at higher yields relative to comparable "straight" corporate bonds. One reason is that the credit enhancements which typically earn synthetics, their ratings might be discounted by the market due to their complexity and contingent nature. The other is that synthetics might have a more limited market and therefore a less liquid secondary market.
- Supply factors. Some issuers (e.g., General Motors Acceptance Corporation) are large and frequent issuers of bonds. They typically are cheaper (i.e., trade at higher yields) than comparable bonds in order to induce portfolios to add to their existing holdings.

- Lags in ratings. Rating agencies are usually conservative in making rating changes. The market typically incorporates information about issuers and the economy in bond prices and yields well ahead of the rating agencies.

A portfolio manager buying corporates would also need to diversify the credit risk exposure of his/her portfolio. He/she would need to consider the holdings by issuer as well as by industry and by exposure to, for example, macroeconomic variables that the manager considers important.

The analysis of rich–cheap bonds would need to take the credit risk factors outlined above into consideration. While several theoretical approaches for the pricing of credit risks have been mooted, experience in understanding the trading patterns and market dynamics of corporate bonds/CDOs is likely to be far more useful in terms of deciding whether a bond is underpriced or overpriced. In addition, the portfolio manager would need to analyze how the default probabilities of the issuer (and the likelihood of default of the specific issue, in cases where the issue is a structured product or where there are seniority considerations involved) are likely to evolve over the holding period of the specific instrument. This would typically mean an analysis of industry - and issuer-specific factors as well as macroeconomic factors that could have a bearing on the issuers' ability to avoid default. Money managers who hold private (nonsovereign) bonds will typically have a dedicated research group focusing on equity-style research into specific issuers and issues. Most money managers take the ratings and analyses by the major rating agencies as the starting point of their evaluation rather than as decision inputs. Ratings by public agencies are important only to the extent of limiting the universe of permitted investments by a registered mutual fund. This typically takes the form of a rating floor; issues with ratings lower than the floor cannot be purchased.

The broad strategies followed by money managers are similar to those outlined in the section on sovereign bonds. The additional complications are the elements of default risk and the relative lack of a secondary market. Liquidity, in particular, is a key in the execution of any strategy.

18.7 Active Management: Multicurrency Approaches

Countries are often at different points on the business cycle. Since interest rate changes (and, thereby, bond prices) are related to the business cycle, this could mean that appropriate bond trading strategies might differ from country to country. From a portfolio manager's perspective, this brings several benefits.

- Diversification. While diversification in corporate bond portfolios helps diversify and reduce credit risks, exposure to international bonds helps interest rate diversification.
- Greater choice set. The portfolio manager has a larger variety of bonds to choose from as well as potentially a larger number of trading strategies to choose from.

- Currency exposure. When buying bonds denominated in different currencies, the purchaser normally takes on currency risk. This becomes a third risk vector (along with interest rate risk and credit risk) which can be managed based on the manager's risk tolerances and the fund's objectives. Managers who are unwilling to take on currency risks can hedge those using short-dated forward contracts or, where deemed appropriate, currency options. Cross-currency derivatives can be used to create exposures in specific currencies.

The specific strategies used are similar to those outlined earlier. Managers who plan to actively trade their portfolios should probably limit their choices to liquid government securities such as those issued by Germany, United Kingdom, United States, and Japan. The increased choice set means that managers can choose buy and sell maturities/duration independently for each country. Managers can also choose the level of interest rate diversification they need.

Managers would also need to decide the level of currency risk they would like to take. While currency movements and interest rate changes are related, currency movements, both in the short and long term, are driven by factors other than interest rate changes. Holding an unhedged foreign currency bond (i.e., a bond where the currency exposure is not hedged) might well have volatility levels significantly higher than that of a similar duration local currency-denominated bond. The portfolio manager would need to decide whether this additional risk is compensated by higher-expected returns.

A safer strategy would be to eliminate currency risks, perhaps by way of rolling short maturity forwards, and focus on interest rate risks. Trading strategies could fall into one of two categories:

1. Those that diversify interest rate risks by taking positions in bonds issued in different monetary policy regimes (Euro-denominated bonds would constitute one monetary regime regardless of country of issue, with individual countries/issuers being distinct credit risks).
2. Those that look to earn the maximum-expected returns, with the larger choice set providing managers with an increased number of alternatives.

Strategies that combine both objectives can also be considered. A portfolio manager might choose to hold a minimum percentage of his portfolio in bonds issued in each of the monetary policy regimes. He/she could increase this holding if the expected returns from a particular regime were significantly higher, without completely eliminating holdings of bonds from other regimes.

18.8 Performance Measurement

Measuring the performance of a portfolio of bonds involves comparison with a naïve portfolio with similar risk characteristics. Equity portfolios are typically compared with well-known indices such as the S&P 500, the Frank Russell indexes for different market capitalization groupings, and similar diversified indices in different markets. The idea is that a naïve investor can invest in an index portfolio at a very low cost and that any actively managed portfolio needs to better this return net of all expenses. In the case of equities, risk is adjusted for by means of measures such as beta.

As outlined earlier, bond portfolios have three sources of risk: interest rate risk, credit risk, and (in the case of bonds denominated in other currencies) currency risk. Since taking on currency risk is a separate investment decision, and since this risk can be hedged in many cases, we will not consider it.

The reference portfolio needs to be a portfolio of bonds whose interest rate risks and credit risks match the investment objectives of the portfolio to be measured. For example, a mutual fund which invests only in sovereign debt would have to be measured against a portfolio with government bonds. A fund which invests in debt above a stated minimum credit rating (investment grade bonds, for example) will be measured against a diversified portfolio that includes only investment-grade bonds. In order to calibrate interest rate risks, the reference portfolio would need to have risks similar to that of a naïve (buy and hold) portfolio with bonds equally distributed across the eligible maturity range. The risks could be calibrated by matching the durations and convexity of the portfolios. The returns on this reference portfolio would be the benchmark against which the portfolio manager's returns would be evaluated.

When evaluating portfolios including corporate or structured bonds, several additional factors need to be considered.

- As mentioned earlier, corporate bonds with similar ratings are not fungible. Plain corporate bonds trade differently than structured bonds with similar ratings, and bond prices/yields might have industry-specific effects as well. Bonds chosen for a reference portfolio would need to match the choice set of the portfolio manager.
- The non-fungibility of corporate bonds implies that any industry-/bond-type weighting will have an impact on returns, and, hence, on the relative performance of specific portfolios.
- Corporate bonds are much less liquid than their treasury counterparts. In addition, trading typically takes place over the counter. Both factors imply that getting prices at which transactions take place is difficult. The implications for portfolio pricing and returns calculations are obvious.
- Recent years have seen a profusion of synthetic bonds, often with unique features. Constructing a "typical" reference portfolio involves making arbitrary decisions about the portfolio's composition, and this, in turn, has an impact on the measured returns of the portfolio.

For these reasons, treasury portfolios with an appropriate risk profile are sometimes used as benchmark portfolios. When comparing a portfolio manager's returns with that of the treasury benchmark portfolio, the difference in returns should ideally be decomposed into an interest rate component and a credit risk component. Doing this implies knowing the maturity decisions taken by the manager. These can be replicated using the treasury portfolio; the residual returns are then due to the credit decisions taken by the manager. Subtracting these residuals from the manager's returns permits the evaluation of the returns from the maturity decisions.

Measuring portfolio performance for bond portfolios is inherently more complicated than for equity portfolios. For the reasons mentioned above, standard bond indices might not be appropriate benchmarks and care needs to be taken to construct appropriate benchmark portfolios. In addition, the portfolio manager's decisions, and hence, performance, can span several vectors, and performance evaluation needs to take this into account. Performance evaluation is also limited by the limited availability of transaction price/yield data on bonds. This is particularly true of corporate bonds and structured bonds, but could also apply to illiquid or off-the-run treasuries. Again, an element of judgment is needed when determining the relevant benchmarks.

18.9 Conclusion

While bonds are analytically more tractable than stocks and derivatives given the predictable cash flows, bond investing is often more complex. Part of the reason for this lies in the fragmented primary issue and secondary markets (this would not, of course, apply to liquid treasury markets). Portfolio managers need to assess whether prices quoted by brokers are reasonable and measurement of performance needs to deal with the price issue as well. A portfolio manager needs to assess and act on both interest rate forecasts and credit risk changes. This chapter has outlined some of the strategies used by active managers and indicated the issues involved in their implementation. More complex strategies add currency changes to the mix. Active strategies need to consider the liquidity of specific instruments when making investment decisions. Drying up of secondary market liquidity has been a frequent cause of losses from bond strategies. Finally, bonds constitute an investment class with particular risk and return characteristics. Any asset allocation exercise would need to decide on the portfolio allocation to bonds. The bond management strategy decision would follow the asset allocation decision.

18.10 End of the Chapter Questions

1. Define passive management. When is it appropriate?
2. Describe money market and treasury funds.
3. Describe the approaches for modeling yield curves.
4. Describe the credit risk and multicurrency approach to active management.

References

Black F, Derman E, Toy W (1990) A one factor model of interest rates and its application to treasury bond options. Financial Anal J Jan–Feb:24–32

Fabozzi F (2000) Bond markets, analysis and strategies. Prentice-Hall, New Jersey

Fama E (1976) Forward rates as predictors of future spot rates. J Financial Econ 3(4):361–377
Cox JC, Ingersoll JE, Ross SA (1985) A theory of the term structure of interest rates. Econometrica 53
Heath D, Jarrow R, Morton A (1987) Bond pricing and the term structure of interest rates: a new methodology. Working Paper, Cornell University, Ithaca
Ho TSY, Lee SB (1986) Term structure movements and pricing interest rate contingent claims. J Finance 41:1011–1029
Hull J, White A (1994) Numerical procedures for implementing term structure models I: single factor models. J Deriv 2(1):7–16
Hull J, White A (1996) Using hull-white interest rate trees. J Deriv 3:26–36
Nelson CR, Siegel A (1987) Parsimonious modeling of yield curves. J Business 60(4):473–489
Svensson L (1994) Estimating and interpreting forward interest rates: Sweden 1992–1994. Discussion Paper No. 1051, Centre for Economic Policy Research
Tuckman B (2002) Fixed income securities: tools for today's markets, 2nd Edn. Wiley, Chichester

Chapter 19
Interest Rate Derivatives

S.R. Vishwanath and Petko Kalev

19.1 Chapter Introduction and Objectives

Investors in fixed income securities (e.g., floating rate notes) are exposed to changes in interest rates and, hence, the value of the portfolio. Such investors would want to lock in their interest rate risk. This chapter provides an overview of interest rate derivatives like swaps, caps, floors, collars, and swaptions that are commonly used by investors to manage interest rate risk.

This chapter has the following objectives:

- Provide an overview of interest rate risk management instruments like swaps and caps
- Discuss the valuation of these instruments
- Introduce the Black's model for valuation of interest rate options like caps
- Introduce the use of standard spreadsheet-based calculators in estimating the cap or the floor premium

The financial environment is a lot more volatile today than it was a decade back. The volatility in interest rates, exchange rates, and commodity prices give rise to an increased risk exposure. In this chapter currency and interest rate swaps, caps, floors, collars, and swaptions used to manage currency and interest rate exposure are discussed.

A swap is an agreement to a future exchange of one stream of cash flows for another. Two common types of swaps are: *currency swaps* in which one currency is exchanged for another at prespecified terms on one or more prespecified future dates, and *interest rate swaps* in which one type of interest rate (e.g., fixed rate) is exchanged for another (e.g., floating rate). Swaps are commonly used by companies and financial institutions to hedge risk or to speculate to make a profit.

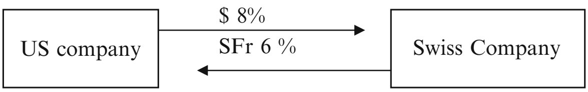
S.R. Vishwanath (✉)
Emirates Institute for Banking and Financial Studies, P.O. Box 4166, Sharjah, UAE
e-mail: srvishy@gmail.com

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_19,

A swap is a privately negotiated agreement between two parties in which both parties are obligated to exchange specified cash flows at periodic intervals for a fixed period of time. A party that intends to swap need not search for a counter party with matching needs. To make our life simple, there are swap dealers who take the other side of the transaction. Swap dealers make a profit by charging a fee or by the difference in bid–ask spread.

19.2 Currency Swap

A currency swap is an agreement between two parties to exchange a given amount of one currency for another and to repay these currencies with interest in the future. To illustrate, consider a US company that has borrowed Swiss Franc (SFr) 200 million at 6% but intends to transform this liability into dollars. At the same time, another Swiss company wishes to convert a $100 million debt bearing 8% interest into SFr liability. Both liabilities have a 4-year maturity. Since the hedging needs of these companies are matching, a mutually beneficial swap can be arranged in which the US company pays 8% interest on dollars to the counterparty for 4 years and the $100 million principal at maturity; and the counterparty pays 6% interest on SFr for 4 years plus SFr 200 million at maturity.



In practice, parties are matched by a swap dealer (a commercial bank, say). Major swap dealers quote bid and offer quotes in all the major currencies for different maturities. The bid and offer rates are the fixed rates in that currency that a bank is willing to pay to a client in exchange for receiving 6-month London Interbank-offered rate (LIBOR) or to receive from a client in exchange for paying 6 million LIBOR. Exhibit 19.1 presents a hypothetical schedule.

All quotes are annual rates against LIBOR.

The price schedule is prepared from the dealer's perspective. Thus, the dealer is willing to pay Sterling at a fixed annual rate of 11.49% in exchange for 6 million

Exhibit 19.1 Hypothetical swap schedule

	Maturity (in %)			
	3 years		5 years	
	Pay	Receive	Pay	Receive
Dollar	8.79	8.97	9.42	9.58
Pound	11.49	11.70	11.45	11.66
Deutsch Mark	5.80	6.10	6.45	6.75
Yen	7.12	7.28	7.02	7.17

LIBOR and to receive Sterling at an annual rate of 11.7% in exchange for paying $6 million LIBOR.[1] The spread between the bid and offer rates is the bank's profit. By relating two quotes to LIBOR, swap rates can be quoted between any two currencies. For instance, the dealer would be willing to pay USD for 3 years at an annual rate of 8.79% in exchange for receiving DM for 3 years at 6.1%, and to receive USD at 8.97% in exchange for paying DM at 5.80%.

Currency swaps are not executed in isolation. They are used in conjunction with actual debt issues. Sometimes companies may find foreign capital cheaper. At the same time they would want to avoid exchange rate risk. Currency swaps enable companies to raise capital in one (cheaper) currency and convert it into the desired currency.

19.3 Interest Rate Swaps

An interest rate swap is a transaction in which an asset or a liability with a floating rate of interest can be converted into a fixed rate (or vice versa) within the same currency. As the currency and amount remains the same, principal is not exchanged. While the fixed rate of interest is set for the life of the contract, the floating rate is reset at the beginning of each interval but paid in arrears. LIBOR is often the reference rate.

19.3.1 An Illustration

A firm can issue dollar-denominated fixed rate debt at 10.75% or it can issue floating rate debt at LIBOR + 25 bp.[2]

Another firm can issue fixed rate debt of the same maturity at 11.7% or floating rate debt at LIBOR + 40 bp.

Firm A prefers floating rate debt while firm B prefers fixed rate debt. Their position is summarized below.

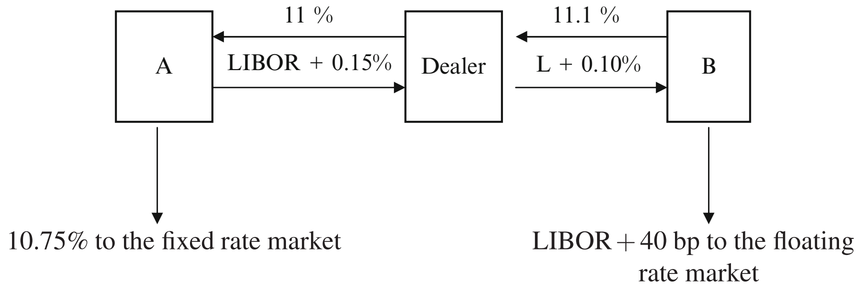
	Fixed	Floating
A	10.75	LIBOR + 25 bp
B	11.70	LIBOR + 40 bp

A dealer arranges an interest rate swap between the two parties. Firm A pays a floating rate of LIBOR + 15 bp to the dealer in exchange for a fixed rate of 11%.

[1] LIBOR is quoted in all the major currencies.

[2] bp stands for basis points. 100 basis points equal 1%. Interest rate less than 1% is quoted in basis points rather than in decimal form.

Firm B pays a fixed rate of 11.1% to the dealer in exchange for a floating rate of LIBOR + 10 bp. The transaction is shown below.



Firm A pays 10.75% to the fixed rate market and LIBOR + 15 bp to the dealer, receives 11% from the dealer. So its net position is LIBOR – 10 bp. Firm B pays 11.1% to the dealer and L + 40 bp to the floating rate market. It receives L + 10 bp. So its net position is 11.40%, approximately.[3] In effect, A has issued debt at LIBOR – 10 bp and B at 11.40%. If A had issued floating rate directly it would pay L + 25 bp. Because of the swap there is a gain of 35 bp. Likewise, B would have paid a fixed rate of 11.70%. Because of the swap the firm is able to reduce it to 11.40%. The intermediary gains 10 bp on the fixed rate leg and 5 bp on the floating rate leg.

As with currency swaps dealers make a market in 6 million LIBOR. The dealer quotes a bid rate which is the rate of interest the dealer will pay for receiving 6 million LIBOR and an offer rate, which is the fixed rate of interest the dealer is willing to accept as payment in exchange for paying 6 million LIBOR. A hypothetical swap quote (for dollar) is given below.

Years	Bid	Offer
3	8.79	8.97
5	9.21	9.36
7	9.48	9.63

Thus, the dealer is willing to pay 9.48% in exchange for receiving 6 million LIBOR for 7 years and to receive 9.63% in exchange for paying 6 million LIBOR.

Interest rate swaps are used to insure against loss in value of assets and increase in value of liabilities due to unanticipated changes in interest rates. Apart from reducing risk, interest rate swaps can also reduce the all-in-cost of debt. In the previous example both parties reduced their cost of borrowing by 30–35 bp.

[3] The fixed rate and floating rate cannot be added or subtracted directly because of different day count conventions. Fixed rate market assumes a 365-day year whereas floating rate market assumes 360-day year.

The swap terminology and swap terms are given below.

Swap terminology	
Notional	: The underlying assets (e.g., currency) is called notional
Value date	: Date on which swap commences
Maturity date	: Termination date
Tenor	: Period of swap
Swap coupon	: Fixed payment
Interest rate swap terms	
Notional amount	: \$5–500 m
Maturity	: 1–12 years
Floating rate indices	: LIBOR, T-Bill rate, commercial paper composite, prime rate
Floating rate reset	: Daily, weekly, monthly, quarterly, or semiannually
Settlement	: Monthly, quarterly, semiannually, or annually
Days' basis	: Actual/360, Actual/365

Another example of interest rate swap is given below.

A company has a \$10 million obligation due in 5 years with a lump sum or bullet maturity with a bank. The loan is priced at LIBOR + 250 bp. Expecting a rise in interest rates, the borrower would like to lock in its interest expense for the next 3 years. The customer enters into a swap in which the bank agrees to pay LIBOR and the customer agrees to pay a fixed rate of 6.5% on the swap. For the next 3 years the customer's actual interest rate is 9%, or the swap rate of 6.5% plus the lending spread of 250 bp. The LIBOR that the customer *pays* on the loan is offset by the LIBOR it *receives* on the swap. Therefore, the LIBOR payments cancel.

Using a basis of Actual/360 in a 31-day month, the following interest settlement proves that the customer's effective rate 9.0%.

If LIBOR is 5.4%

Interest payment $= 5.4\% + 250\,\text{bp} = 7.9\%$
Interest on loan $= 7.9\% \times 31/360 \times \$\,10\,\text{million} = \$\,68{,}027.78$
Receipt on swap $= 5.4\% \times 31/360 \times \$\,10\,\text{million} = \$\,46{,}500.00$
Payment on swap $= 6.5\% \times 31/360 \times \$\,10\,\text{million} = \$\,55{,}972.22$
Net payout by customer $= \$\,77{,}500$
Effective interest rate $= 77{,}500/10$ million $\times\, 360/31 = 9\%$

19.4 Pricing Interest Rate Swaps

Interest rate swap terms, typically, are set so that the present value of the counterparty payments is at least equal to the present value of the payments to be received. Present value is a way of comparing the value of cash flows now with the value of cash flows in the future.

Because an interest rate swap is just a series of cash flows occurring at known future dates, it can be valued by simply summing the present value of each of these cash flows. In order to calculate the present value (PV) of each cash flow, it is necessary to first estimate the correct discount factor for each period on which a cash flow occurs. Discount factors are derived from investors' perceptions of interest rates in the future and are calculated using forward rates such as LIBOR. The following formula calculates a theoretical rate (known as the swap rate) for the fixed component of the swap contract.

$$\text{Theoretical swap rate} = \frac{\text{PV of the floating rate payments}}{\sum\limits_{T=1}^{\Sigma} \text{Notional principal} * (\text{days}_{\text{t}}/360) * \text{df}_t}$$

Consider the following example:

An issuer and a counterparty agree to a \$100 million swap starting in January 2008 that calls for a 3-year maturity with the issuer paying the swap rate (fixed rate) to the counterparty and the counterparty paying 6-month LIBOR (floating rate) to the issuer. Using the above formula, the swap rate can be calculated by using the 6-month LIBOR futures rate to estimate the PV of the floating component payments. Payments are assumed to be made on a semiannual basis (180-day periods). The calculations are given below.

19.4.1 Step 1: Calculate the Numerator

The first step is to calculate the PV of the floating rate payments. This is done by forecasting each semiannual payment using the LIBOR forward (futures) rates for the next 3 years. The calculations based on actual semiannual payments are presented in Exhibit 19.2.

Exhibit 19.2 Estimating the present value (*PV*) of floating rate payments

Time Period	Annual forward rate (%)	Semi annual forward Period rate (%)	Actual floating rate Payment at end period	Floating rate forward discount factor	PV of floating rate Payment at end of period (\$)
A	B	C	D	E	F
1/08-6/08	4	2	\$2m	0.9804	1960800
7/08-12/08	4.25	2.13	\$2.125m	0.96	2040000
1/09-6/09	4.50	2.25	\$2.25m	0.9389	2112525
7/09-12/09	4.75	2.38	\$2.375m	0.9171	2178113
1/10-6/10	5	2.50	\$2.5m	0.8947	2236750
7/10-12/10	5.25	2.63	\$2.625m	0.8718	2288475

19.4.2 Step 2: Calculate Denominator

As with the floating rate payments, LIBOR forward rates are used to discount the notional principal for the 3-year period. The PV of the notional principal is calculated by multiplying the notional principal by the days in the period and the floating rate forward discount factor. The calculations are shown in Exhibit 19.3.

19.4.3 Step 3: Calculate Swap Rate

Using the results from the previous steps, the theoretical swap rate can be derived.

$$\text{Theoretical swap rate} = \$12,816,663/\$278,145,000 = 4.61\%$$

The issuer (fixed rate payer) will be willing to pay a fixed 4.61% rate for the life of the swap contract in return for receiving 6-month LIBOR.

19.4.4 Step 4: Calculate Swap Spread

The market convention is to use a US treasury security of comparable maturity as a benchmark. For example, if the 3-year T-Note had a yield to maturity of 4.31%, the swap spread in this case would be 30 bp (4.61% − 4.31% = 0.30%).

While understanding the theoretical underpinnings from which swap rates are derived is important to the issuer, computer programs designed by major financial institutions and market participants have eliminated the issuer's need to perform complex calculations to determine pricing. Exhibit 19.4 presents a swap calculator designed by the World Bank.

Exhibit 19.3 Present value (*PV*) of notional principal

Notional principal = $100m

Time period	Annual forward rate (%)	Semi annual forward Period rate (%)	Floating rate forward discount factor	PV of notional Principal
1/08-6/08	4	2	0.9804	49,020,000
7/08-12/08	4.25	2.13	0.96	48,000,000
1/09-6/09	4.50	2.25	0.9389	46,945,000
7/09-12/09	4.75	2.38	0.9171	45,855,000
1/10-6/10	5	2.50	0.8947	44,735,000
7/10-12/10	5.25	2.63	0.8718	43,590,000
			PV of notional principal	278,145,000

Exhibit 19.4 International Bank for Reconstruction and Development (*IBRD*) swap calculator

Underlying/Desired Loan Characteristics

Loan Parameters

	Existing Loan Parameters	Desired Loan Parameters
Currency (EUR/JPY/USD)		
Interest rate type (F/V)		

Spread (in Basis Points)	
Fixed Interest Rate(%)	
Principal Amount (to be converted)	
Effective Date	
Maturity Date of the Swap	

Footnotes

1. Three choices of currency are available -- USD, JPY and EUR
2. Symbols for fixed and floating interest rate type are "F" and "V" respectively.

Reset Amortization Schedule

Compute Rate/Spread

Current Amortization Schedule

Date	Outstanding Principal

Market Data

Money Market and Swap Rates(%)

Maturity	USD	EUR	JPY
3m			
6m			
12m			
2y			
3y			
4y			
5y			
6y			
7y			
8y			
9y			
10y			
12y			
15y			
25y			
30y			

Basis Swap Cost (Basis Points)

Maturity	USD-JPY	USD-EUR	EUR-JPY
1y			
2y			
3y			
4y			
5y			
7y			
10y			
15y			
20y			

Exchange Rates

1 USD =		EUR
1 USD =		JPY
1 EUR =		JPY

Source: World Bank

19.5 Unwinding Interest Rate Swap Transactions

An important benefit of using derivatives is the ease with which they can be canceled, or unwound. Issuers may want to unwind a swap transaction for a variety of reasons like

- The company may no longer have any need for the hedge since the underlying debt has been retired (e.g., a debt issue or a loan has amortized faster than anticipated)
- The issuer has changed its view of the direction of interest rates and no longer wants the protection

The issuer may want to change the profile of its hedging strategy by extending or shortening the tenor.

Swaps can be unwound in two ways:

- Swaps can be unwound by entering into another swap that is equal and opposite to the original. For instance, if a customer has a swap with 3 years remaining, and is paying a fixed rate of 7% and *receiving* 3-month LIBOR, it would enter into a 3-year swap to receive the prevailing market fixed rate of 6.5%, for example, and *pay* LIBOR. With the exception of the 50 bp differential between the original rates of 6.5%, the swaps cancel each other out and the customer reverts to the original interest rate basis. The customer still owes 50 bp for the next 3 years. If prevailing rates were higher at the time of unwinding, the customer would revert to its original rate floating basis and *receive* an annuity from the swap dealer.
- The second method entails reducing the value of the annuity (50 bp in the above example) to a single present value and making a one time up-front payment. In this case no new swap is entered into and the existing swap is simply terminated releasing both parties from further obligation under the original swap agreement.

19.6 Estimating the Termination Value of a Swap

Once the swap transaction is completed, changes in market interest rates will change the payments on the floating component of the swap. At the initiation of a swap, the PV of the fixed rate cash flows will be zero at a specific interest rate. If interest rates increase shortly after an interest rate swap has been initiated, the current market expectations are that the future floating rate payments due under the swap will be higher than those originally expected when the swap was priced. This benefit will accrue to the fixed rate payer under the swap and will represent a cost to the floating rate payer.

If the new cash flows due under the swap are computed and if these are discounted at the appropriate new rate for each future period (i.e., reflecting the current swap yield curve and not the original swap yield curve), the positive PV reflects how the value of the swap to the fixed rate payer has increased from the initial value of zero and the value of the floating component has declined from the initial zero to a negative amount.

If the floating rate payer were to terminate the contract at this point in time, they would be liable to the fixed rate payer for this amount.

The change in swap value to issuer as rates change is shown below.

	Rates rise	Rates fall
Issuer pays fixed	+	−
Issuer receives fixed	−	+

19.7 Interest Rate Caps

Interest rate caps, floors, and collars are option-based interest rate risk management products.

These option products can be used to establish maximum (cap) or minimum (floor) rates or a combination of the two which is referred to as a collar structure. These products are used by investors and borrowers alike to hedge against adverse interest rate movements.

An interest rate cap is a contract that guarantees a maximum level of LIBOR. A cap can be a guarantee for one particular date, known as a caplet. Caps are also known as ceilings. In return for making this guarantee, the buyer pays a premium. Caps generally guarantee a maximum level of either 3- or 6-month LIBOR or whatever the prevailing floating rate index is in the particular market. The client's maximum loss on a cap transaction is the premium.

After purchasing the cap, the buyer can make "claims" under the guarantee should LIBOR be above the level agreed on the cap on the settlement dates. A cap is not a continuous guarantee; claims can only be made on specified settlement dates. These dates are selected by the purchaser.

Should the buyer never be required to make a claim under the cap, the option will expire worthless. At settlement, a caplet has a profit profile as follows:

To reiterate, an interest rate cap is an over-the-counter (OTC) derivative that protects the holder from rises in short-term interest rates by making a payment to the holder when an underlying interest rate (the "index" or "reference" interest rate) exceeds a specified strike rate (the "cap rate"). Caps are purchased for a premium and typically have expirations between 1 and 7 years. They may make payments to the holder on a monthly, quarterly, or semiannual basis, with the period generally set equal to the maturity of the index interest rate.

Each period, the payment is determined by comparing the current level of the index interest rate with the cap rate. If the index rate exceeds the cap rate, the payment is based upon the difference between the two rates, the length of the period, and the contract's notional amount. Otherwise, no payment is made for that period. If a payment is due on a USD LIBOR cap, it is calculated as

$$(\text{Index rate} - \text{cap rate})\ [\text{Actual days}/360]\ (\text{Notional amount})$$

Exhibit 19.5 Cap payments

Year	Index (6 month LIBOR) (%)	Payment (m)
½	6.25	0
1	7.75	0.25
1 ½	7	0
2	8.5	1
2 ½	8	0.5
3	6.25	0

For example, Exhibit 19.5 illustrates a 3-year, $200 million notional cap with 6-month LIBOR as its index rate, struck at 7.5%. The exhibit shows what the cap's payments would be under a hypothetical interest rate scenario.

Caps are frequently purchased by issuers of floating rate debt who wish to protect themselves from the increased financing costs that would result from a rise in interest rates. To reduce the up-front cost of such protection, a long cap may be combined with a short floor to form a collar.

A cap can be thought of as a series of interest rate options called caplets. Caps are priced by valuing the individual caplets and summing the values. The Black (1976) option pricing formula is the market convention for quoting implied volatilities for caps.

A difficulty in pricing options on commodities, for instance, is nonrandomness in the evolution of many commodity prices. For example, the spot price of an agricultural product will generally rise prior to a harvest and fall following the harvest. Similarly, natural gas tends to be more expensive during winter months than summer months. Because of such nonrandomness, many spot commodity prices cannot be modeled with a geometric Brownian motion, and the Black and Scholes (1973) or Merton (1973) models for options on stocks do not apply. In 1976, Fischer Black published a paper addressing this problem (Black 1976; Black and Scholes 1973; Merton 1973). His solution was to model forward prices as opposed to spot prices. Forward prices do not exhibit the same nonrandomness of spot prices. Consider a forward price for delivery shortly after a harvest of an agricultural product. Prior to the harvest, the spot price may be high, reflecting depleted supplies of the product, but the forward price will not be high. Because it is for delivery after the harvest, it will be low in anticipation of a drop in prices following the harvest. While it is not reasonable to model the spot price with a Brownian motion, it may be reasonable to model the forward price with one. Black's (1976) option pricing formula reflects this solution, modeling a forward price as an underlying in place of a spot price. The model is widely used for modeling European options on physical commodities, forwards or futures. It is also used for pricing interest rate caps and floors. The model is popularly known as Black (1976) or simply Black's model.

Values for a call price c or put price p, according to the model, are:

$$c = e^{-\mathrm{rt}}[f\mathrm{N}(d_1) - x\mathrm{N}(d_2)]$$
$$p = e^{-\mathrm{rt}}[x\mathrm{N}(-d_2) - f\mathrm{N}(-d_1)]$$

where

$$d_1 = \frac{\ln(f/x) + (\sigma^2/2)t}{\delta\sqrt{t}}$$
$$d_2 = d_1 - \delta\sqrt{t}$$

$f =$ current underlying forward price
$x =$ strike price
$r =$ continuously compounded risk-free interest rate
$\sigma =$ implied volatility for the underlying forward price
$\mathrm{N} =$ standard normal cumulative distribution function

Caps are usually quoted with an up-front premium. If they are quoted with an implied volatility, it is with a flat implied volatility across all caplets.

19.8 Pricing of Caps

The cap price (premium) has two major components:

- Intrinsic value

When the strike of the cap is lower than the implied forward rate, the cap is said to have intrinsic value. The implied forward is the market-expected rate, and, therefore, if we seek a guarantee of a lower rate, the expected value of the cap is positive, so it has intrinsic value. A cap that has a strike lower than the implied forward (i.e., has positive intrinsic value), is described as in-the-money. A cap with negative intrinsic value is described as out-of-the-money. A cap set at the implied forward is described as at-the-money-forward. A cap set at the current LIBOR level is at-the-money-spot. The relevant implied forward is the swap rate for the period of the cap or the FRA (forward rate agreement) rate for a caplet.

- Time value

The cap is a guarantee of a future rate. The implied forward rate will change over time as the market changes its view of future rates. The price of the cap will, therefore, depend on the likelihood that the market will change its view. This likelihood of change is measured by volatility. An instrument expected to be volatile between entry and maturity will have a higher price than a low volatility instrument. The volatility used in calculating the price should be the expected future volatility. This is based on the historic volatility.

As time goes by, the volatility will have less and less impact on the price, as there is less time for the market to change its view. Therefore, in a stable market, the passing of time will lead to the cap falling in value. This phenomenon is known as time decay. This increases in severity as we get closer to maturity.

19.9 Reversing Caps

Bought caps can be sold at any time. The value of the cap will depend on the same factors above, intrinsic value and time value. The intrinsic value is calculated by comparing the strike with the implied forward levels. The time value will depend on the amount of time left before maturity (less time less value) and the volatility of the underlying instrument (high volatility higher value).

19.10 Interest Rate Floors

Interest rate floors compare to interest rate caps in the same way that puts compare to calls. They are OTC derivatives that protect the holder from declines in short-term interest rates by making a payment to the holder when an underlying interest rate (the "index" or "reference" interest rate) falls below a specified strike rate (the "floor rate"). Floors are purchased for a premium and, typically, have maturities between 1 and 7 years. They may make payments to the holder on a monthly, quarterly, or semiannual basis, with the period generally set equal to the maturity of the index interest rate.

Each period, the payment is determined by comparing the current level of the index interest rate with the floor rate. If the index rate is below the floor rate, the payment is based upon the difference between the two rates, the length of the period, and the contract's notional amount. Otherwise, no payment is made for that period. In US markets, if a payment is due on a USD LIBOR floor, it is calculated as

$$(\text{Floor rate} - \text{Index rate})\ [\text{Actual days}/360]\ (\text{Notional amount})$$

For example, Exhibit 19.6 illustrates a 3-year, \$200 million notional floor with 6-month LIBOR as its index rate, struck at 5.5%. The exhibit shows what the floor's payments would be under a hypothetical interest rate scenario.

Just as a cap can be thought of as a series of caplets, a floor can be thought of as a series of interest rate options called floorlets. Floors are priced by valuing the individual floorlets and summing the values. The Black (1976) option pricing formula is the market convention for quoting implied volatilities for floors. Floors are usually quoted with an up-front premium. If they are quoted with an implied volatility, it is typically with a flat implied volatility across all floorlets.

Exhibit 19.6 Floor payments

Index (%)	Payment
6.75	USD 0MM
5.25	USD .25MM
6.25	USD 0MM
4.50	USD 1MM
5.00	USD .5MM
6.75	USD 0MM

19.11 Pricing Floors

The floor price (premium) has two major components:

- Intrinsic value

When the strike of the floor is higher than the implied forward rate, the floor is said to have intrinsic value. The implied forward is the market-expected rate, and, therefore, if we seek a guarantee of a higher rate, the expected value of the floor is positive, so it has intrinsic value. A floor that has a strike higher than the implied forward (i.e., has positive intrinsic value), is described as in-the-money. A floor with negative intrinsic value is described as out-of-the-money. A floor set at the implied forward is described as at-the-money-forward. A floor set at the current LIBOR level is at-the-money-spot.

The relevant implied forward is the swap rate for the period of the floor or the FRA rate for a floorlet.

- Time value

The floor is a guarantee of a future rate. The implied forward rate will change over time as the market changes its view of future rates. The price of the floor will, therefore, depend on the likelihood that the market will change its view. This likelihood of change is measured by volatility. An instrument expected to be volatile between entry and maturity will have a higher price than a low volatility instrument. The volatility used in calculating the price should be the expected future volatility. This is based on the historic volatility.

As time goes by, the volatility will have less and less impact on the price, as there is less time for the market to change its view. Therefore, in a stable market, the passing of time will lead to the floor falling in value. This phenomenon is known as time decay. This increases in severity as we get closer to maturity.

19.12 Reversing Floors

Bought floors can be sold at any time. The value of the floor will depend on the same factors above – intrinsic value and time value. The intrinsic value is calculated by comparing the strike with the implied forward levels. The time value will depend on the amount of time left before maturity (less time less value) and the volatility of the underlying instrument (high volatility higher value).

19.13 IBRD Cap/Floor Calculator

To clients using International Bank for Reconstruction and Development's (IBRD's) LIBOR-based loan products, the IBRD offers interest rate caps and collars to provide protection against rising interest rates. Interest rate caps are individually negotiated transactions which set an upper limit on the interest a borrower would pay on a floating rate loan against payment of an up-front premium. Interest rate collars are individually negotiated transactions which set an upper limit and a lower limit (a collar) on the interest a borrower would pay on a floating rate loan against payment of an up-front premium. Interest rate caps and collars are available both as embedded options on fixed spread loans (FSLs) or as free-standing hedges linked to disbursed and outstanding variable spread loans (VSLs).

The IBRD has developed a cap/floor calculator, an Excel program which can be used to calculate indicative pricing for interest rate caps, floors, and collars (Exhibit 19.7).

19.14 Interest Rate Collars

A collar is created by combining a cap and a floor. Collars can benefit both borrowers and investors. In the case of a borrower, a collar protects against rising interest rates but limits the benefits of falling rates. In the case of an investor, the collar protects against falling rates but limits the benefits of rising rates. Similar to caps and floors, the customer selects the index, the length of time, and the strike rates for the cap and the floor. An up-front premium may or may not be required depending on the strike rates. The customer is a buyer of one product and a seller of the other because of which the premium payments may get cancelled (these are called costless collars).

The counterparties agree upon the tenor, the strike rates, the notional amount, amortization, the start date, and the settlement frequency. The payment is calculated as the difference between the strike rate and the index times the notional amount outstanding times the days' basis for settlement.

19.15 Swaptions

An interest rate swaption is an option on an interest rate swap. It gives the holder the right but not the obligation to enter into an interest rate swap at a specific date in the future, at a particular fixed rate for a specified term. The customer selects

Exhibit 19.7 International Bank for Reconstruction and Development (*IBRD*) cap/floor calculator

Input Parameters

	USD
	Cap
Option Type	Cap
Initial Principal	1,000,000
Strike (%)	6
First Payment Date	6/15/2002
Last Payment Date	12/15/2006
Trade Date	1/16/2001
Volatility (% per year)	15

Output

Cap Premium	#NAME?

Reset Amortization Schedule

Current Amortization Schedule

Date	Outstanding Principal
12/15/2001	1,000,000.00
6/15/2002	1,000,000.00
12/15/2002	1,000,000.00
6/15/2003	1,000,000.00
12/15/2003	1,000,000.00
6/15/2004	1,000,000.00
12/15/2004	1,000,000.00
6/15/2005	1,000,000.00
12/15/2005	1,000,000.00
6/15/2006	1,000,000.00
12/15/2006	1,000,000.00

Money Market and Swap Rates(%)

Maturity	USD	EUR	JPY
3m	6.715	4.81	0.53
6m	6.640	4.70	0.53
12m	6.555	4.65	0.54
2y	6.387	4.66	0.60
3y	6.403	4.75	0.77

the strike rate at which it enters the interest rate swap agreement, the length of the option period, the floating rate index, and tenor by paying an up-front premium.

The counterparties agree on the strike rate, length of the option period (the starting date of the swap if the swaption is exercised), the term of the swap, notional amount, amortization, and frequency of settlement.

The holder benefits if the market rates are higher than the strike rate, with the flexibility to enter into the current market swap rate if they are lower.

Swaptions are of three types based on the exercise style. European swaptions can be exercised only on the maturity date of the option. American swaptions can be exercised at any time during the option period. Bermudan swaptions can be exercised on specific dates during the option period.

A swaption is depicted on a time-line diagram given below.

Time (years)		
0	2	5
Borrower Buys a swaption Borrower pays floating rate on loan	Exercise Date If the 3 year swap rate is above the strike, swaption is exercised; party pays fixed, receives floating If the swap rate is below or equalto strike Rate, swaption is not exercised	

Swaptions can be priced on several indices with different calculation bases.

Index	Days' basis	Terms
Prime	Actual/360	1–10 years
LIBOR	Actual/360	1–10 years
CP	Actual/360	1–10 years
	Actual/365	
US treasuries	Actual/365	1–10 years

19.16 Concluding Comments

This chapter outlined some of the interest rate derivatives like interest rate swaps, caps, floors, collars, and swaptions. Interest rate derivatives like swaps and collars find application in managing floating rate portfolios (from the perspective of investors). Investors can invest in floating rate instruments and convert the floating rate receipts to fixed rate.

The subsequent chapters deal with measuring and managing credit risk – the other factor that affects the value of fixed income portfolios.

19.17 End of the Chapter Questions

1. How are interest rates different from currency swaps?
2. What is the rationale for currency swaps?
3. Explain the steps in pricing interest rate swaps.
4. Describe the Black's model for pricing of interest rate caps.
5. What are the components of value of a floor?
6. How can caps or floors be reversed? How are interest rate swaps reversed?

References

Bicksler J, Chen AH (1986) An economic analysis of interest rate swaps. J Finance 41(3):645–655
Black F (1976) The pricing of commodity contracts. J Financial Econ 3:167–179
Black F, Scholes M (1973) The pricing of options and corporate liabilities. J Polit Econ 81:637–654
Dattatreya RE, Hotta K (1993) Advanced interest rate and currency swaps: state-of-the art products strategies and risk management applications. Irwin, Chicago, IL
Hull J (1989) Assessing credit risk in a financial institution's off-balance sheet commitments. J Financial Quant Anal 24:489–502
Hull J, White A (1985) The impact of default risk on the prices of options and other derivative securities. J Bank Finance 19:299–322
Hull J, White A (1992) The price of default. RISK September:101–103
Litzenberger RH (1992) Swaps: plain and fanciful. J Finance 47(3):831–850
Marshall JF, Kapner KR (1993) Understanding swaps. Wiley, New York, NY
Merton R (1973) Theory of rational option pricing. Bell J Econ Manage Sci 4:1
Smith CW, Smithson CW, Wakeman LM (1986) The evolving market for swaps. Midland Corp Finance J 3:20–32
Turnbull SM (1987) Swaps: a zero sum game. Financial Manage 16(1):15–21
Wall LD, Pringle JJ (1989) Alternative explanations of interest rate swaps: a theoretical and empirical analysis. Financial Manage 18(2):59–73

Chapter 20
The Credit Market

S.R. Vishwanath and Krishnamurti Narasimhan

20.1 Chapter Introduction and Objectives

The recent sub-prime crisis in the United States has generated significant turmoil among banks and financial institutions that invest in fixed income securities like mortgage-backed securities. As pointed out in Chap. 16, the size of the fixed income market is much bigger than the stock market, and hence, attracts a lot of attention among both academics and practitioners. In this chapter, we discuss credit markets and address the following questions:

- What are credit markets
- What is credit risk, who bears it
- Who generates information about credit quality
- How do we model credit risk

20.2 Introduction

The credit market can be thought of as that part of the fixed income market where credit quality of the obligor is an important consideration. While US Treasury instruments are a big part of the fixed income market, the fact that the obligor in that market, namely, the US government, is virtually risk free, makes credit risk a non-issue there. However, any bond issued by a corporate bears the risk that the issuer may become delinquent making these instruments sensitive to credit quality of the issuer.

Thus, credit risk borne by a lender can be defined as the risk of a decline in the borrower's creditworthiness. This would include the risk of the borrower's outright

S.R. Vishwanath (✉)
Emirates Institute for Banking and Financial Studies, P.O. Box 4166, Sharjah, UAE
e-mail: srvishy@gmail.com

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_20,

inability to meet her obligations in a timely manner (which would constitute a default event) or just a decline in the borrower's credit quality (which would be realized through a ratings downgrade by a credit rating agencies.) It is well known that bonds are priced as the present value of their cash flow stream. Thus, the inability of a borrower to make a timely payment will impact the timing of the cash flow and hence affect the price of the security. In the worst case, namely, if a borrower is unable to make any scheduled payments, it would lead to significant drop in the price of the bond. From its definition, it is clear that credit risk pervades all financial transactions where some form of credit is extended. As an example, we consider below the type of credit risk faced by type of financial institution.

20.2.1 Commercial Banks

- Corporate/Wholesale banks – The focus of these institutions is to lend to large, small, and medium corporate enterprises to support their business needs. In doing so, such banks are subject to credit risk of the borrowing corporate entity. These banks either lend the whole amount required by the corporate thereby taking on the entire exposure or participate in a lending syndicate thereby taking only a portion of the exposure.
- Retail banks – The focus of these institutions is usually retail business mainly mortgage loans, auto loans, and credit card loans. They also make limited loans to small businesses. These banks have significant credit exposure to the borrowing individuals and small businesses. They usually take on the entire exposure as the borrowed amounts are small compared to corporate loans.

20.2.2 Investment Banks

- While investment banks do not directly lend to corporate or retail entities, a major part of their activity is trading securities and arranging and underwriting debt issuances for various types of borrowers. Trading securities exposes these institutions to the credit risk associated with their trade counter parties. Similarly, as part of their trading activity, these institutions hold credit-sensitive securities issued by several types of obligors, and hence they are exposed to the credit risk associated with those obligors. Arranging and underwriting debt issuances also exposes these institutions to the credit risk associated with the issuer as these institutions would have to take the issue on their own balance sheets should they not be able to sell the issue entirely.

20.2.3 Institutional Investors

- Any investor that holds securities issued by obligors whose creditworthiness could change over time bear the credit risk of the obligor. Thus, if the investor is holding corporate bonds and if one of the corporates were to get downgraded or default, that would have a material impact on the value of the portfolio. It is clear from the above discussion that all major financial institutions bear some form of credit risk. The accurate measurement of credit risk is very important for all participants in the financial markets as it allows them to quantify the overall risk in the assets they hold or are considering for investment. Given the diverse nature of borrowers, obligors can range from individuals to corporations to sovereigns. Any issuer of a credit sensitive instrument would be an obligor. Some of the credit sensitive instruments include the following:
  - *Loans* – Loans can be both secured and unsecured in nature. Bank loans secured by an asset and automobile loans would be examples of secured loans while credit card loans would be an example of unsecured loan.
  - *Mortgages* – Residential mortgages taken out by individuals to finance homes and commercial mortgages taken out to finance purchase of commercial real estate would be examples of mortgages.
  - *Derivative products* – Products such as credit default swaps are examples of credit-sensitive derivative products. Such instruments can be used to express an opinion on credit quality or for hedging purposes.
  - *Structured credit products* – CMOs, CLOs, and other structured products that have mortgages, loans, or credit card debt as assets also have inherent credit risk. While it is clear that credit quality of the borrower is important to the lender/investor, it is very important for the borrower as well. The cost at which the borrowers raise money is a function of their credit quality.

20.3 Information on Credit Quality

As we have discussed, credit risk of the obligor is a very important consideration for all participants in the market as it determines the overall risk and value of the lender's portfolio and the overall cost to the borrower. However, credit risk, unlike market risk, is not easily observed. Information on credit quality can be obtained primarily from two sources, namely, "credit rating agencies" and "market prices."

20.4 Credit Rating Agencies

A rating agency is one that evaluates the creditworthiness of an obligor and assigns a credit rating that publicly reflects its opinion. The rating assigned by the agency is a reflection of the agencies opinion regarding the borrowers creditworthiness arrived at from the public and private information available to it about the borrower and through its rigorous analytical work using this information. The higher the assigned rating, the higher the perceived quality and the lower the risk associated with the borrower; similarly, the lower the assigned rating, the lower the perceived quality, and hence the higher the risk associated with the borrower. Rating agencies have been performing this function for over a century and the importance of their role and the influence of their opinion on the market has increased significantly during this time – on the one hand, their opinion influences the borrowers access to the market and the cost of their borrowing; on the other, it influences which securities an investor will buy based on his risk profile. They offer credit opinion on all form of issuances including sovereign debt issuance to bond issuance to structured finance issuances. The three best known rating agencies are Standard and Poor's, Moody's, and Fitch. As the significance of credit ratings has increased, the role of these agencies has grown to become an internationally. For example, S&P, on its Web site, claims to have $32 trillion outstanding debt rated by it in 100 countries. Similarly, Moody's claims to be tracking debt covering more than 100 sovereign nations. The credit rating agencies issue a letter rating based on detailed credit analysis conducted by them which reflects their opinion of the issuer's ability to meet its obligation in a timely manner. Exhibit 20.1 presents Fitch's long-term ratings and their definitions.[1]

In addition, the rating agency uses the modifiers "+" or "−" along with a rating to denote relative status within major rating categories. Thus, "AA+" would indicate a rating level that is credit quality that is better than a AA, but below a AAA, where as a "AA−" would denote credit quality that is marginally below AA, but higher than an A. Such suffixes, however, are not added to the "AAA" long-term rating category, and to categories below "CCC."

The original credit rating is assigned by the rating agency at the time of issuance to reflect the credit risk associated with the security at that time. After the issuance, the rating agency continuously monitors the issuer to ensure that there is no material change that will impact the creditworthiness of the security – if the agency, as part of its monitoring identifies a change, it will issue a rating action to reflect the new level of risk involved. This rating action could either be a rating downgrade, reflecting an increase in the security's credit risk, or be a ratings upgrade, reflecting a decrease in the security's credit risk. On the basis of studies of long-term rating changes, rating agencies also produce probabilities that any security assigned a given rating will transition into another rating level. These are called transition probabilities. Exhibit 20.2 presents Fitch's global corporate finance average annual transition rates from 1990 to 2005.[2]

If we look at the first row of the matrix, what it tells us is that a AAA rated security at the beginning of the year has a 95.94% probability of being rated AAA at the end of the year, a 3.93% probability of being downgraded to a AA, a 0.13%

[1] Please refer to "Fitch Ratings Definitions" on the corporate Web site of Fitch Ratings www.fitchratings.com.

[2] "Fitch Ratings Global Corporate Finance 1990–2005 Transition and Default Study," August 3, 2006.

Exhibit 20.1 Fitch ratings definitions

Investment grade	AAA	Highest credit quality. 'AAA' ratings denote the lowest expectation of credit risk. They are assigned only in case of exceptionally strong capacity for payment of financial commitments. This capacity is highly unlikely to be adversely affected by foreseeable events
	AA	Very high credit quality. 'AA' ratings denote expectations of very low credit risk. They indicate very strong capacity for payment of financial commitments. This capacity is not significantly vulnerable to foreseeable events
	A	High credit quality. 'A' ratings denote expectations of low credit risk. The capacity for payment of financial commitments is considered strong. This capacity may, nevertheless, be more vulnerable to changes in circumstances or in economic conditions than is the case for higher ratings
	BBB	Good credit quality. 'BBB' ratings indicate that there are currently expectations of low credit risk. The capacity for payment of financial commitments is considered adequate but adverse changes in circumstances and economic conditions are more likely to impair this capacity. This is the lowest investment grade category
Speculative grade	BB	Speculative. 'BB' ratings indicate that there is a possibility of credit risk developing, particularly as the result of adverse economic change over time; however, business or financial alternatives may be available to allow financial commitments to be met. Securities rated in this category are not investment grade
	B	For issuers and performing obligations, 'B' ratings indicate that significant credit risk is present, but a limited margin of safety remains. Financial commitments are currently being met; however capacity for continued payment is contingent upon a sustained favorable business and economic environment
	CCC	For issuers and performing obligations, default is a real possibility. Capacity for meeting financial commitments is solely reliant upon sustained, favorable business or economic conditions
	CC	For issuers and performing obligations, default of some kind appears probable
	C	For issuers and performing obligations, default is imminent
	RD	Indicates an entity that has failed to make due payments (within the applicable grace period) on some but not all material financial obligations, but continues to honor other classes of obligations
	D	Indicates an entity or sovereign that has defaulted on all of its financial obligations

probability of being downgraded to a single-A, and virtually no chance of being downgraded beyond that. Similarly, looking at row two, we find that a AA rated

Exhibit 20.2 Fitch's global corporate finance average annual transition rates from 1990 to 2005 (%)

	AAA	AA	A	BBB	BB	B	CCC to C	D
AAA	95.94	3.93	0.13	0	0	0	0	0
AA	0.12	92.02	7.49	0.32	0.02	0.02	0	0
A	0.02	2.38	92.43	4.78	0.24	0.04	0.07	0.04
BBB	0.02	0.25	4.32	90.33	3.94	0.59	0.26	0.3
BB	0.04	0.09	0.18	7.05	82.06	7.05	2.03	1.5
B	0	0	0	0.73	13.46	80.02	4.03	1.77
CCC to C	0	0	0	0.33	0.66	16.17	56.77	26.07

Exhibit 20.3 Exhibit 20.3 Average volume-weighted corporate default rate between 1994 and 2006 for the Moody's rated universe (%)

	Year 1	2	3	4	5
AAA	0	0	0	0	0
AA	0	0	0	0	0
A	0.3	0.67	0.99	1.21	1.49
BBB	0.59	1.4	2.1	3	3.8
BB	1.75	3.92	6.28	8.63	10.54
B	5.43	12.87	19.25	24.18	27.53
CCC to C	24.36	37.18	46.11	51.46	53.54

security has a 0.12% probability of being upgraded to a AAA rating while it has a 92.02% probability of remaining AA rated at the end of the year. In addition to the transition matrices, the ratings agencies also undertake studies of long-term defaults and losses among issuers in their rated universe. By assuming that the long-term trend will remain the same, one can draw inferences about default probabilities and expected losses from these studies.

Exhibit 20.3 presents the average volume-weighted corporate default rate between 1994 and 2006 for the Moody's rated universe.[3] By looking at the first row in that matrix, what we infer is that the likelihood of default for the "AAA" rated bond over a 5-year period is negligible.

Similarly shown in Exhibit 20.4 are the cumulative credit loss rates from 1982 to 2006 from the same Moody's publication. As before, assuming that future recovery rates will continue to be in line with historically observed rates, we can forecast expected losses to credit portfolios using information from this table.

The ratings agencies take a long-term "through-the-cycle" view on credit risk. What this means is that the ratings agencies only react to fundamental changes in a borrower's/securities profile, and not temporary changes in market conditions that impact the borrower's credit risk. This implies that credit ratings are very sticky and often do not reflect the immediate concerns of the market. Taking a closer look at the

[3] "Corporate Default and Recovery Rates, 1920–2006," Moody's, June 27, 2007.

Exhibit 20.4 Cumulative credit loss rates from 1982 to 2006 (%)

	Year 1	2	3	4	5
AAA	0	0	0	0	0.3
AA	0	0.01	0.03	0.05	0.11
A	0.01	0.05	0.12	0.2	0.26
BBB	0.11	0.3	0.53	0.87	1.17
BB	0.74	2.08	3.69	4.96	6.37
B	3.32	7.33	10.83	13.63	15.74
CCC to C	13.22	20.89	25.83	28.62	34.6

transition matrix, this seems obvious as the diagonal elements (i.e., the probability that a rating would remain unchanged at the end of the year) is exceptionally high, being well over 90% for most of the investment grade ratings, over a 15-year period. As a result, it is obvious that while the ratings offer a good relative measure of credit risk among various borrowers or securities, they do not give an absolute measure of the risk involved and the probabilities of default associated with a rating level could vary considerably during different business cycles. Thus, while credit ratings are a very useful relative metric, there is a need for another information source that provides a more accurate absolute measure of credit risk, one that takes market conditions and concerns into consideration in a timely manner.

20.5 Market Data

The financial markets provide valuable and timely information on the credit quality of issuers by incorporating this information, in the form of a credit spread, in observable market metrics like bond prices. The credit spread is measured as the difference in yield between a defaultable bond and a US government bond of comparable maturity. This "higher yield or excess spread" that needs to be paid to an investor is to compensate her for bearing the incremental risk over a comparable treasury. Thus, given a bond price series, we should be able to back out the implied loss expectation. In order to illustrate this, let us consider the example of a zero coupon corporate bond, maturing in 1 year and yielding 5.25% while a 1-year treasury bonds yields 5%. On the basis of above information, we can get the prices for the two bonds as follows:

$$\text{One-year Treasury bond price} = e^{-0.05\times 1} = \$95.12$$
$$\text{One-year corporate bond} = e^{-0.0525\times 1} = \$94.89$$

The corporate bond trades at a 0.2497% discount to the Treasury bond, implying that the corporate bond investor is expecting a loss of this magnitude over the 1 year until maturity. Generalizing this, we derive implied loss from time "0" to time "t",

$$\text{implied loss}(0,t) = 1 - e^{-[y(t)-rf(t)]t}, \text{ where,}$$

$y(t)$ is the yield of a risky bond maturing at time t, rf is the risk-free or benchmark rate, $y(.) - rf(.)$ is the credit spread.

Extending this further, we have implied loss from time "$t1$" to "$t2$" as,

$$\text{implied loss}(t1,t2) = \text{implied loss}\,(0,t2) - \text{implied loss}\,(0,t1)$$
$$\text{implied loss}\,(t1,t2) = e^{-[y(t1)-rf(t1)]t1)} - e^{-[y(t2)-rf(t2)]t2}$$

An important point to note, however, is that expected losses arrived at using credit spreads are significantly higher than empirically observed losses. The primary reason for this is that only a small fraction of the credit spread is on account of credit risk. Other things that go into determining credit spreads are liquidity premium, tax considerations, skewness of payoff structure, difficulty in portfolio diversification, and so on. Thus, any model that uses credit spreads to back out credit risk needs to take these factors into consideration.

20.6 Modeling Credit Risk

Credit risk is a very important consideration for all financial market participants and there is keen interest in measuring it as accurately as possible so that it can be managed effectively. Given that credit risk is not readily observed, a significant amount of effort is being spent on modeling it. The various components that need to be considered while modeling credit risk are as follows.

20.6.1 Probability of Default (PD)

This is the central piece in credit risk modeling. It can be thought of as the estimation of the likelihood that an obligor will default on her obligation. The PD can be measured to span the life time of the obligation or over some shorter horizon, such as 1 year.

20.6.2 Credit Exposure (CE)

In the event an obligor defaults, the credit exposure defines how much of the extended credit will be at risk. It is this fraction of the extended credit that can take a loss or be impaired in some manner.

20.6.3 Recovery Rate (RR)

Recovery rate measures the expected value that will be recovered should the obligor default. Historically, estimating recovery rates was as much a focus as the estimation of probability of default. This is because RR was thought of as being entirely dependent on the individual features of the underlying collateral and not a function of systematic factors. Recently, however, this has changed and a significant amount of effort is being expended in estimating RR.

With the estimation of the above three parameters, the Expected Loss (EL) associated with each obligor can be calculated as follows:

$$\mathrm{EL} = \mathrm{PD} \times \mathrm{LGD}, \text{ where}$$

LGD is the Loss Given Default and can be calculated as CE $\times\,(1 - RR)$.

The older models of credit risk, for the most part, used some form of credit scoring, where, based on a set of factors, the obligor would be assigned a credit score which in turn would map into a specific measure of credit risk. However, with the advent of very complex credit securities an increasing need for sophisticated credit models was felt. This requirement, coupled with the availability of cheap computing power allowed for the development of an increasingly quantitative framework in credit modeling. The approaches to analyzing credit risk can be classified into two main categories, namely,

1. Structural Approach
2. Reduced Form Approach

20.6.3.1 Structural Approach

The foundation for the structural approach is based on the original framework developed by Merton using the option pricing principle. Here, the liabilities of a firm are thought of as contingent claims on its assets and default is thought to occur when the market value of the firm's assets is lower than the face value of debt. Hence, assuming that a firm's debt is made up of zero coupon bonds, if the market value of the firm's assets is greater than the face value of the bonds, then the bondholder gets the full face value at time of maturity. If however, the market value of the firm's assets is lower than the face value of the bonds, then the bondholder gets back the market value of the firm, and incurs a loss. Thus the payoff structure for the bondholders at maturity can be thought of as,

$$\text{Payoff} = \text{Min}\,(\text{face value of bond market value of firm})$$

It is clear that in these models, the credit risk of an obligor is a function of the market value assets and a well-defined default threshold/barrier. There are several limitations to the Merton model such as the assumption that default only occurs at maturity, which is clearly not realistic in the real world as defaults can occur at anytime during the life of the bond. Similarly, this model assumes only one class of debt, where as firms have different types of debt with different seniority structure and often times this structure is not strictly adhered to upon default. Several modifications to the original Merton model have been made, with each model attempting to remove several of the unrealistic assumptions in the original framework.

As the structural model is built up from theory, the impact of each variable can be quantifies explicitly. As a result, its strength can be though of as the ability of diagnose and change the credit characteristics of a portfolio through a set of well-defined inputs. However, its limitation lies in the fact that while we assume we can accurately characterize a default process in theory, in reality, it is virtually impossible to do so.

20.6.3.2 Reduced Form Approach

The reduced form approach assumes no knowledge of the underlying default process. It takes the view that a firm's default time is unpredictable and is driven by a default intensity that is a function of unobservable or latent variables. Thus, in this model, the default process of a firm is not a function of its asset value and we need not estimate asset values to compute the credit risk. This model considers current market prices to represent the true value of the security under risk neutral valuation. Thus, this model calibrates to market prices and is less bound by underlying theory. The strength of this approach lies in that we can make excellent in-sample predictions, given that we calibrate to sample. Furthermore, the flexibility and tractability of this form of modeling is very attractive as it does not require the modeler to specify an underlying default process. The shortcoming of this approach, however, lies in that while we may be able to calibrate to in-sample, with no clear understanding of the underlying process, our out-of sample estimates could be very poor. Furthermore, any prescriptive work would be very difficult, as the underlying drivers are not clearly understood.

20.7 Conclusion

Credit markets can be though of as that part of the fixed income market where "credit risk" is a very significant consideration. All major participants in the financial markets are subject to credit risk. The fact that an obligor can default on his obligation with a non-zero probability has significant implications on the pricing of credit-sensitive portfolios and on the need to manage the risk effectively. It is therefore very important to have timely and accurate information on the creditworthiness of the obligors. There are two primary sources of credit information. The ratings agencies assign "letter grades" to the various obligors that reflect their creditworthiness. The assigned grades are important not just to the investor, but also to the obligor as it has a significant impact on their access to the markets and the cost of their borrowings. The ratings agencies continuously monitor the obligors and take ratings actions if they perceive any material change to their creditworthiness. However, the ratings agencies have a "through the-cycle" perspective on credit quality and hence, their ratings, while providing a relative rank of obligors, does not provide an absolute measure of quality. Furthermore, their ratings are very sticky and do not reflect immediate market concerns. Market prices provide us with another source of credit information is observable market prices. Thus, from credit spreads, we can back out the market implied credit risk. It is, however, important to note that expected losses backed out by this method usually are significantly higher than empirically observed and this is because credit risk accounts for only a small portion of the total credit spread.

With the need to better quantify credit risk, an enormous amount of effort has gone into this endeavor. While the older models used simple credit scoring techniques, the current trend is towards more quantitative models. There are two broad approaches that can be taken to quantitatively model credit risk. One approach, the structural model, uses the Merton framework and defines default as a function of the asset value of the firm. This approach is intuitively appealing in that it is ground in theory and hence can be used as a diagnostic and prescriptive tool. The other approach, namely, the reduced form approach, assumes no knowledge of the default process. Thus, this method is less intuitive but offers the attraction of being more tractable.

20.8 End of the Chapter Questions

1. What is credit risk?
2. Explain the meaning of rating symbols used by Fitch ratings.
3. Describe the types of credit risk faced by different institutions.
4. Summarize the findings on rating transitions and default rates for different classes of ratings.
5. Describe the two approaches for credit risk modeling.

Chapter 21
Investing in Credit Derivatives

Paul Ali

21.1 Chapter Introduction and Objectives

The on-going turmoil in the United States sub-prime mortgage market – and, more recently, the sub-prime mortgage-related losses being reported by some of the world's largest banks – have brought into sharp focus the risks of investing in credit derivatives, even where the credit derivatives are not linked predominantly to sub-prime mortgages but, instead, cover apparently diversified pools of mortgages and other bank loans (Economist 2007). The obvious credit risk associated with sub-prime mortgages and the losses that have eventuated when, as expected, many of these mortgages defaulted or could not be re-financed have, however, taken many investors by surprise. Yet this element of surprise is perhaps explicable when one takes into account the complex and often opaque nature of the arrangements by which the credit risk of sub-prime mortgages has often been passed on to investors.

This chapter provides an overview of credit derivatives, a rapidly growing derivative product.

This chapter has the following objectives:

1. Define credit derivatives
2. Describe the five types of credit derivatives
3. Highlight what credit derivatives accomplish
4. Introduce securitized credit derivatives

The author recognizes the assistance of the Australian Research Council (DP0557673).

P. Ali
Melbourne Law School, The University of Melbourne, 3010 Victoria, Australia
e-mail: pua@unimelb.edu.au

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_21,

21.2 Introduction

The ongoing turmoil in the United States sub-prime mortgage market – and, more recently, the sub-prime mortgage-related losses being reported by some of the world's largest banks – have brought into sharp focus the risks of investing in credit derivatives, even where the credit derivatives are not linked predominantly to sub-prime mortgages but, instead, cover apparently diversified pools of mortgages and other bank loans (Economist 2007). The obvious credit risk associated with sub-prime mortgages and the losses that have eventuated when, as expected, many of these mortgages defaulted or could not be re-financed have, however, taken many investors by surprise. Yet this element of surprise is perhaps explicable when one takes into account the complex and often opaque nature of the arrangements by which the credit risk of sub-prime mortgages has often been passed on to investors.

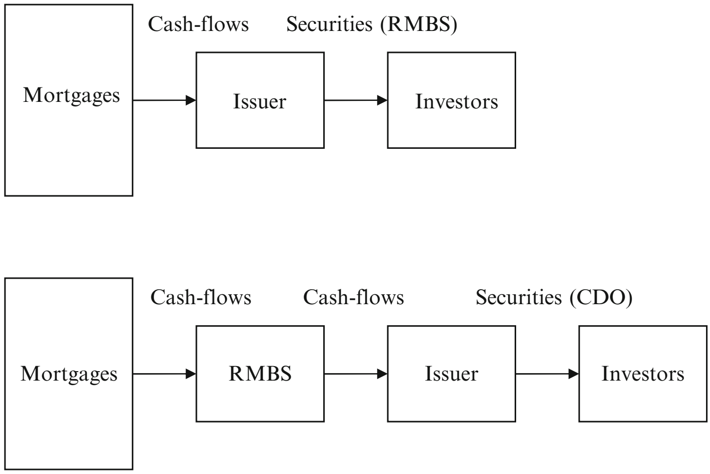
Commercial banks and other originators of mortgages have routinely made use of securitization to both fund and hedge their exposure to mortgages (and other loans). The RMBS (Residential Mortgage-Backed Securities) structures employed to accomplish this are relatively transparent – and so should be well understood – as regards the transfer of credit risk to investors. Debt securities are issued to investors and the cash proceeds from the issuance of the securities are used to purchase mortgages, with the cash-flows generated from the repayment of the mortgages being used to service principal and interest payments on the securities. There is a direct – and clear – link between the performance of the securities and the performance of the securitized mortgages. In addition, it should be no surprise to an investor that where different tranches of securities are issued, the junior or subordinated tranches are more exposed to the credit risk of the underlying mortgages than the senior tranches.

This link may, however, be less obvious to investors where the securities have been "re-securitized" and there is at least a second securitization structure interposed between the securities held by the investors and the mortgages (Moody's Investors Service 2007). In a typical re-securitization involving mortgages, known as a cash CDO (Collateralized Debt Obligations), the securities held by the investors are used, not to fund the acquisition of mortgages, but, instead, to fund the acquisition of securities that have been issued as part of a RMBS structure. The securitization and re-securitization of mortgages are depicted in Exhibit 21.1.

For many investors, the first inkling of their exposure to sub-prime mortgages has come in the form of losses incurred on the junior tranches of CDO securities, due to defaults on the sub-prime mortgages to which those tranches are linked. CDO securities backed (indirectly) by sub-prime mortgages now appear to be the single largest medium through which institutional investors, in particular pension funds and money market funds, have assumed exposure to the credit risk of sub-prime mortgages (Evans 2007a,b). This is, moreover, increasing evidence that educational endowments have also invested heavily in CDO securities linked to sub-prime mortgages (Evans 2008a,b).

This, however, is only an incomplete description of the use of securitization to transfer the credit risk of mortgages (and other bank loans) to investors. In the case of both the RMBS and CDO structures outlined above, the transfer of credit risk

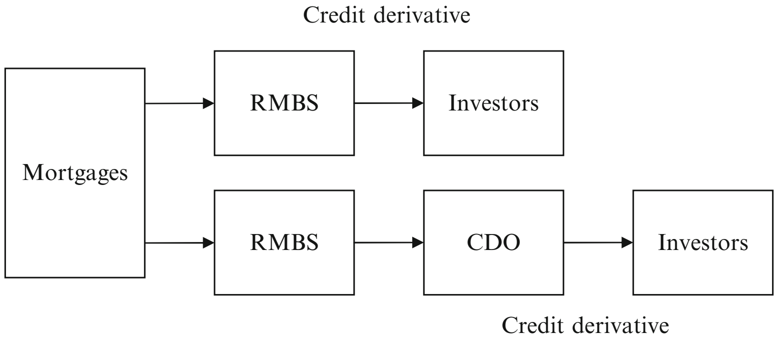
Exhibit 21.1 Securitization and re-securitization of mortgages



is effected through the acquisition of mortgages and mortgage-backed securities, respectively. The issuer, by acquiring mortgages or mortgage-backed securities, assumes, as a consequence of its ownership of those assets, all of the risks, including credit risk, associated with the assets. Those risks are, in turn, passed on to the investors as the acquisition has been funded by the investors and the repayment of the monies owed to the investors (in the form of principal and interest on the securities issued to the investors) is dependent upon the acquired assets generating sufficient cash-flows (Ali 2005).

The same result – in the form of exposure to the credit risk of sub-prime mortgages and other bank loans – can be achieved through investing in credit derivatives. Credit derivatives make it possible to separate the credit risk of an asset from both ownership of that asset and the other risks associated with the asset (Ali 2005). This has greatly facilitated the hedging of credit risk in relation to bank loans (and allowed banks to free-up the risk capital that would otherwise have to be held against those loans) (Ali 2005). Moreover, credit derivatives can, in common with all other derivatives, be used to create credit risk for investors as opposed to transferring an existing credit risk to investors. Just as it is no longer necessary to transfer ownership of an asset in order to lay-off the credit risk associated with that asset so too is it now no longer necessary for a bank or any other party "transferring" the credit risk in relation to an asset to own asset or even have an existing exposure to that credit risk (via a credit risk mitigation instrument such as a guarantee, letter of credit, or even other credit derivatives) (Ali, 2005). Accordingly, investors can readily obtain exposure to the credit risk of mortgages and other bank loans by investing in securities backed by credit derivatives linked to those assets without the need for the issuer of the securities to acquire the assets. This allows for a considerably more customized form of credit exposure, tailored to the risk appetite of particular investors as the extent and type of exposure created is no longer dependent upon the sourcing of actual assets (Nomura Securities 2004).

Exhibit 21.2 Simplified depiction of a synthetic re-securitization



Transparency is unlikely to be an issue for investors where the credit derivatives backing the securities are linked directly to mortgages, including sub-prime mortgages. That, however, is not usually the case with investments in credit derivatives linked to mortgages. It is far more common for such securities to be backed by credit derivatives linked to RMBS or even CDO securities (where the latter are, in turn, backed by RMBS). It is these "synthetic" securitizations of CDO securities and RMBS where the link to the credit risk of the underlying sub-prime mortgages may not be transparent to the investors, particularly where the RMBS includes mortgages other than sub-prime mortgages or the CDO includes debt instruments other than mortgages.

That link is depicted in Exhibit 21.2.

This chapter discusses the legal aspects of investing in credit derivatives. First, the chapter explains more fully the securitization structures involving credit derivatives through which investors have obtained exposure to sub-prime mortgages (and other bank loans). Second, the chapter examines the key legal constraint on investing in credit derivatives in the context of institutional investors, such as pension funds and money market funds, which constitute the single largest class of investors in credit derivatives.

21.3 Credit Derivatives

Credit Derivatives are contracts between two financial market participants. The essence of the contract is concerned with transferring credit risk from one party to another. Credit risk is the risk of the debtor's default on financial claims. Credit derivatives enable the transfer of credit risk from the lender to someone else and, thus, provides the lender the possibility to hedge against a debtor's default.

The half-yearly credit derivatives data released by ISDA say that credit derivatives volumes, as of end June, 2007, have gone beyond $45 trillion, at about $45.46 trillion. This scales a growth of 32% from the $34 trillion data as of end 2006, and nearly 75% growth over the half year of 2006.

Credit derivatives have been growing at an annual rate of nearly 100% over the past 3–4 years.

During the tremendous credit squeeze that started in the wake of the sub-prime crisis, credit derivatives volumes are likely to be affected this year (2007–2008). There are several reasons for this – hedge funds which became primary players in credit derivatives in 2004 onwards are likely to stage a retreat, or at least slow their activity this year. CDO activity is completely moribund post July 2007. In general, the market has become risk averse.

There are basically five types of credit derivatives being used in the global market. They are Credit Default Swaps, Total Return Swaps, Credit Spread products, Credit risk options, and Credit Linked Notes.

A credit default swap is an option where the risk seller pays a premium (measured in basis points of the nominal amount) to the risk buyer. In the case of a credit event, the risk buyer is paying a credit event payment. Common credit events include failure to pay, bankruptcy, cross default, restructuring, merger, downgrading.

In case of credit event, the value loss of the underlying is to be compensated by the credit event payment. Credit event payments are defined in three ways:

1. Cash settlement: The risk buyer pays the difference between par and the recovery value of the underlying
2. Physical Settlement: The risk buyer receives the underlying and pays the nominal value to the risk seller
3. Binary: The buyer pays a fixed amount specified in the contract.

A Total Return Swap involves the sale of not only the credit risk involved in an underlying bond, but also the market risk caused by interest rate changes.

In a total return swap the payer who normally owns a reference asset pays all interest rate payments and possible positive market price changes of the underlying. The other party (the receiver) is paying LIBOR plus or minus a spread, the possible negative market price changes of the underlying, and the loss occurring in case of a default. To reimburse the counterparty for the credit risk taken, the LIBOR payment is applied to a lower notional amount than the coupon on the reference asset. The total return receiver's position is equivalent to a long credit risk position and the Total Return payer's position is equivalent to a short credit risk position which hedges the latter's position in the reference asset.

A credit spread put is an instrument which enables to hedge away the credit spread risk, that is, the risk of an increasing spread between the interest rate of a corporate bond and the reference interest rate which is LIBOR for floating rates and T bond yield for fixed interest rates. If the spread increases above the negotiated strike spread, the option can be exercised and the reference asset will be delivered at strike.

The put buyer pays an option premium for the protection against rising spreads. The underlying reference asset is a bond or a pool of bonds.

A credit risk option protects an investor against changes in payments as well as defaults. Assume that a company intends to issue bonds in 2 months. The company is concerned that the credit rating may decline in 2 months because of which the proceeds would be less than anticipated. The company can purchase a credit risk option in which the writer agrees to pay the buyer (the company) the difference in proceeds due to credit rating decline.

In credit linked notes investors buy a bond whose interest payments and final payment are linked to the credit standing of an underlying reference asset. As compensation for taking this risk the coupon of such a note is increased by the embedded option premium.

21.4 Securitized Credit Derivatives

Over half of the securitized credit derivatives sold to investors in the United States – and over a third of securitized credit derivatives sold to investors worldwide – carry some degree of exposure to the credit risk of US sub-prime mortgages (Fitch Ratings 2007a). Although the exact level of credit risk assumed in relation to sub-prime mortgages varies from structure to structure, in all instances it is the junior-most tranches of the securitized credit derivatives that are the most vulnerable to defaults on those mortgages – and pension funds have been among the largest investors in these junior tranches (Evans 2007a).

The complexity of the structures involved – in summary, the interposition of credit derivatives linked to RMBS and CDO securities between the underlying mortgages and the ultimate investors – may have made it less obvious to some investors that an investment in the junior tranche of securitized credit derivatives is equivalent to investing entirely or substantially in sub-prime mortgages. That can be the case even where the RMBS covers mortgages other than sub-prime mortgages (see Exhibit 21.3).

That may be equally the case with an investment in the junior tranche of securitized credit derivatives linked to CDO securities that are backed by RMBS (see Exhibit 21.4).

The exposure to the credit risk of the RMBS or CDO securities is accomplished, in common with the RMBS and CDO securities themselves, through the purchase of credit risk. In the case of the latter, this is, as noted above, accomplished through the

Exhibit 21.3 Junior RMBS tranche and credit derivatives

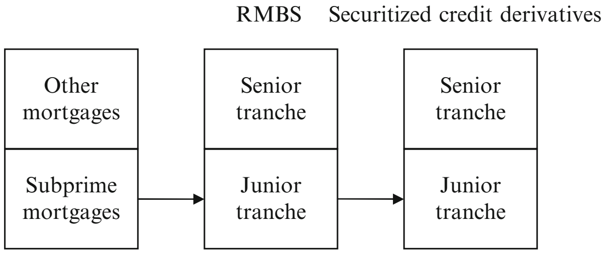
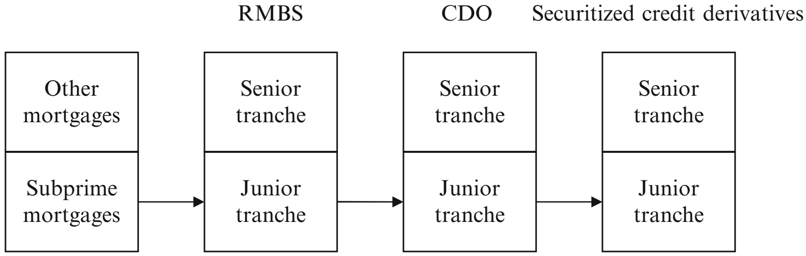


Exhibit 21.4 Junior CDO tranche and credit derivatives



use of the proceeds from the issuance of securities to the investors to purchase either mortgages or RMBS. The investors are exposed to the credit risk of the mortgages or RMBS since the payment of principal and interest on the securities held by the investors is contingent upon the mortgages or RMBS generating sufficient cash-flows. In contrast, in the case of securitized credit derivatives, the proceeds from the issue of securities to the investors are used to support the issuer's assumption of credit risk under a type of credit derivative known as a "credit default swap" (Ali 2005, 2007). Payment of principal and interest on the investors' securities is contingent upon those proceeds not being depleted by the issuer having to make payments in respect of the credit default swap (Ali 2005, 2007).

A credit default swap is basically a contract between the issuer and a third party (typically, a commercial bank, investment bank, or hedge fund) under which the former agrees, in exchange for the payment to it of a fee by the latter, to assume the credit risk in relation to certain specified debt obligations (such as RMBS or CDO securities) (Ali 2005, 2007; Fitch Ratings 2007b). This means that if the issuer or other obligor in relation to those debt obligations defaults in making a payment in respect of those obligations when due (as, a result for example, of insufficient cash-flows being generated by the underlying mortgages due to defaults on those mortgages) or becomes bankrupt, the issuer will obligated to make a cash payment to the third party reflecting the fall in value of the debt obligations (Ali 2005, 2007). That cash payment, in the case of securitized credit derivatives, may be expressed as a fixed percentage of the face value of the debt obligations or calculated by reference to the market value of those obligations (Ali 2007).

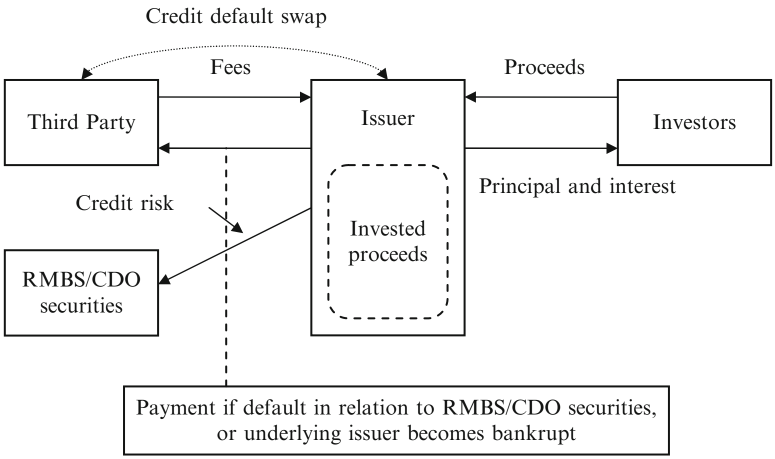
The credit risk assumed by the issuer – that is, the risk that the issuer will have to make a payment under the credit default swap – is passed on to the investors by making the issuer's obligation to pay principal and interest on the securities held by them contingent upon the issuer not being required to make a payment under the credit default swap during the term of the securities (Ali 2005, 2007). If the underlying RMBS or CDO securities perform according to their terms, the investors will receive interest on the scheduled payment dates and the securities will be redeemed for their face value on the scheduled maturity date (Ali 2005, 2007). If, however, there is a default in respect of the RMBS or CDO securities or the issuer of those securities becomes bankrupt, the securities held by the investors will typically be immediately redeemed for any positive balance remaining following the application of the cash proceeds held by the issuer toward the discharge of the issuer's payment obligation under the credit default swap (Ali 2005, 2007). The payment made by the issuer under the credit default swap necessarily depletes the amount available to meet the claims of the investors and, in this manner, the investors are exposed to the credit risk of the RMBS or CDO securities to which the credit default swap is linked (Ali 2005, 2007).

The balance of the proceeds held by the issuer following the making of this payment under the credit default swap is used to redeem the investors' securities in order of seniority, with the senior tranche being redeemed ahead of the junior tranche (Ali 2007). Only after the senior tranche has been redeemed in full will any remaining proceeds being used to redeem the junior tranche (Ali 2007). The senior tranche thus has the benefit of the subordination of the junior tranche and, depending on the level of protection or subordination provided by the junior tranche and proportion of sub-prime mortgages referable to the underlying RMBS or CDO securities, the investors in a junior tranche of securitized credit derivatives may be fully exposed to the credit risk of the sub-prime mortgages (see Figs. 3 and 4). It is possible, depending upon the severity of the default and the ranking of the tranche of RMBS or CDO securities, to which the credit default swap is linked, for the principal amount of the securities held by the investors to be entirely or substantially depleted.

The interest payments on the securities are designed to compensate the investors for this exposure to credit risk. These payments are funded by a combination of the fees paid to the issuer under the credit default swap and the cash-flows generated by the issuer's investment of the proceeds from the securities issued to the investors (Ali 2005, 2007). Exhibit 21.5 depicts a generic securitization of credit derivatives.

The use of securitized credit derivatives to shift the credit risk of RMBS and CDO securities (and, thus, the credit risk of underlying sub-prime mortgages) to investors has been greatly facilitated by the publication of the International Swaps

Exhibit 21.5 Securitized credit derivatives



and Derivatives Association (ISDA) of standard-form documentation for credit default swaps linked to RMBS, CDO securities, and other asset-backed securities (de Vries Robbé 2006; Parker 2007). One of the most important issues covered in this documentation is settlement, as, in contrast to the assets typically linked to securitized credit derivatives, RMBS, and CDO securities are illiquid. This lack of liquidity makes it difficult to value defaulted RMBS and CDO securities and may impede settlement of the issuer's payment obligations under the credit default swap as well as impeding redemption of the securities held by the investors (de Vries Robbé and Ali 2005; de Vries Robbé 2006; Parker 2007). The ISDA documents – which are used mainly for securitized credit derivatives linked to RMBS and CDO securities in the US and European markets – provides for settlement alternatives to the cash settlement described above, following the issuer's payment obligation under the credit default swap being triggered.

In the case of the so-called "non-PAUG template" developed by ISDA for the European market, the third party can substitute, at its election, physical settlement (with the issuer being required to purchase the underlying RMBS or CDO securities – or specified substitute debt obligations – from the third party for their full face value), or synthetic delivery (where a total return swap synthesizing the total returns on the RMBS or CDO securities is entered into by the issuer or the third party in place of the credit default swap) for cash settlement (de Vries Robbé 2006; Parker 2007). The other three ISDA documents (the "pay as you go" or PAUG templates), which were developed for the US market, provide for an ongoing process of settlement during the term of the credit default swap with the issuer being required to compensate the third party for shortfalls suffered by the latter in relation to cashflows from the RMBS or CDO securities until the termination of the swap (de Vries Robbé 2006; Parker 2007). The third party can substitute PAUG settlement or physical settlement, at its election, for cash settlement in the case of the Form I and CDO PAUG templates published by ISDA while the Form II PAUG template published by ISDA provides only for PAUG settlement (de Vries Robbé 2006; Parker 2007).

21.5 Institutional Investors and Securitized Credit Derivatives

Institutional investors, including pension funds and money market fund, have, to date, been the largest investors in securitized credit derivatives (Evans 2007a, b). As explained above, this investment in credit derivatives has, typically, been effected through the purchase of debt securities linked to credit derivatives – with the result that the investor in the securities assumes not only the credit and other risks of the issuer of the securities but also the credit risk of the assets, including sub-prime mortgages, that underlie the credit derivatives. However, unlike the proprietary trading desks of banks and the relatively small number of corporations that participate in the market for these debt securities, institutional investors can be said to be "legally constrained" in their investment activities.

Institutional investors do not, in contrast to the proprietary trading desks of banks, invest for their own account. They, instead, invest for the benefit of their own investors, that is, the persons who, for example, have made contributions to a pension fund or deposited cash in a money market fund account. As a result, not of the particular legal medium through which the investment activities of the institutional investor are being conducted but of the fact that the institutional investor is undertaking the investment of funds entrusted to it by the other parties, the institutional investor is not legally able to invest in securitized credit derivatives with the same degree of freedom enjoyed by, for instance, the proprietary trading desk of a bank.

The critical constraint on an institutional investor's investment activities is to be found in the legal duty of prudence – the so-called "prudent investor rule" – that applies to all parties who are in the business of investing on behalf of others. This rule applies to institutional investors in common law markets, including the United States and United Kingdom (Ali et al. 2003; Bines and Thel 2004). Failure to comply with this duty exposes the institutional investor to personal liability to its own investors for the losses incurred in respect of any non-complying investments or even for the relative underperformance attributable to such investments (Ali and Russell 2000).

The prudent investor rule imposes on institutional investors the requirement to ensure that the funds entrusted to them are invested in a manner consistent with their investment strategy and investment objectives (as expressed in the institutional investor's governing rules, including its investment mandate), having regard, in particular, to the expected return contribution of the investment to overall returns of the investor's portfolio, the impact of the investment on the overall risk profile of the portfolio, the requirements of investor for liquidity, regularity, and stability of income, capital preservation, and the impact of the investment on portfolio diversification (Ali et al. 2003; Bines and Thel 2004).

This whole-of-portfolio approach to investment selection mandated by the prudent investor rule, while it does not automatically exclude complex or risky instruments, such as, in particular, the junior tranches of securitized credit derivatives, means that an institutional investor considering allocating the funds under its management to an investment in securitized credit derivatives must

- understand the legal structure of the securitized credit derivatives, including the terms of the credit default swap via which the investors are exposed to the credit risk of the underlying RMBS or CDO securities, and the ranking of the investor's claim for principal and interest (as determined by the tranche of securities held by the investor);
- understand the risk and return attributes of the securitized credit derivatives, including whether the interest rate payable on the securities held by the investor is sufficient compensation for the credit risk assumed by the investor and the terms on which the structure may be ramped-up (allowing for the inclusion of new credit risks);
- understand the situations in which the principal amount of the securities will be depleted by a deterioration in the credit quality of the assets linked to the credit default swap (e.g., the investor's principal will be exposed to risk of loss in the event of one or more payment defaults in respect of the sub-prime mortgages or other assets that ultimately underlie the structure); and

- assess the liquidity of the securities (bearing in mind that, in the event that the principal amount of the securities is depleted, there may be no secondary market for those securities).

For many institutional investors, the attraction of securitized credit derivatives lies primarily in the interest rates carried by the securities, particularly in respect of the junior tranches of the securities, compared to conventional debt instruments (Evans 2007a, b, 2008a, b). What, however, some institutional investors appear to have overlooked in their desire to boost the returns of their portfolios is that this factor alone is not sufficient to ensure compliance with their duty of prudence. The investors in securitized credit derivatives are effectively purchasing credit risk (in many instances, ultimately, in relation to sub-prime mortgages) for a fee (represented by the interest rate payable on the securities) and are placing their principal at risk. An institutional investor must ensure that it is adequately compensated for that risk and in order to determine the adequacy or otherwise of that compensation, the investor must understand the structure of the securitized credit derivatives, their riskiness, and their liquidity. In addition, given that many securitized credit derivatives incorporate the credit risk of sub-prime mortgages (and that the credit quality of those mortgages will be impaired by a downward trend in housing prices as well as worsening employment condition), an institutional investor may discover that the diversification benefits of securitized credit derivatives may be illusory or minimal due to the likely correlation between the performance of sub-prime mortgages and the price performance of shares and other conventional investment assets.

21.6 Conclusion

This chapter provides an overview of institutional investment in securitized credit derivatives. In many instances, the securitization of credit derivatives has involved the transfer of the credit risk of sub-prime mortgages to institutional investors. While the structures involved can be complex and may even have masked the link between the securities issued to the investors and the credit risk of the sub-prime mortgages (and other assets) that ultimately underlay these structures, it seems that a significant number of institutional investors were simply seduced by the high interest rates payable on the junior tranches of securitized credit derivatives and made little, if any, effort to understand exactly what it was they were investing in. In the absence of evidence of fraud or other misconduct on the part of the persons selling the securitized credit derivatives, one must ask whether these institutional investors complied with the requirements of the prudent investor rule – and it is likely that at least some of them did not.

21.7 End of the Chapter Questions

1. Define credit derivatives.
2. Describe the five types of credit derivatives.
3. What do credit derivatives accomplish?
4. What are mortgage-backed securities and collateralized debt obligations?
5. What are securitized credit derivatives?

References

Ali PU (2005) Credit derivatives and synthetic securitization: innovation and fragility. Bank Finance Law Rev 20:293–317

Ali PU (2007) Credit derivatives. In Ali PU (ed) Secured finance transactions. Globe Law and Business, London

Ali PU, Russell T (2000) Investor remedies against fiduciaries in rising and falling markets. Company Secur Law J 18:326–350

Ali PU, Stapledon G, Gold M (2003) Corporate governance and investment fiduciaries. Thomson Legal & Regulatory, Sydney

Beder TS, Iacono F (1997) The good, the bad- and the ugly? RISK, July

Bines HE, Thel S (2004) Investment management law and regulation, 2nd edn. Aspen, New York

Chacko G et al (2005) Note on credit derivatives. HBS Case No. 9-205-111, November 17

Das S, Lynagh S (1999) An overview of credit derivatives. HBS Case No. 9-297-086, March

de Vries Robbé JJ (2006) CDS of ABS: structured credit and securitisation at the cutting edge. In: de Vries Robbé JJ, Ali PU (eds) Innovations in securitisation. Kluwer Law International, The Hague

de Vries Robbé JJ, Ali PU (2005) The continuing evolution of the structured credit market. J Int Bank Law Regul 20(12):628–632

Economist (2007) At the risky end of finance (19 April)

Evans D (2007a) The poison in your pension. Bloomberg Markets: 64–70 (July)

Evans D (2007b) Unsafe havens. Bloomberg Markets:36–54 (October)

Evans D (2008a) The subprime in the schoolhouse. Bloomberg Markets:60–74 (January)

Evans D (2008b) Peddling tainted debt to Florida. Bloomberg Markets:61–70 (February)

Fitch Ratings (2007a) Global US subprime exposure in synthetic collateralized debt obligations. Structured Credit Special Report (16 April)

Fitch Ratings (2007b) CDx survey – market volumes continue growing while new concerns emerge. Credit Policy Special Report (16 July)

Moody's Investors Service (2007) The impact of subprime residential mortgage-backed securities on Moody's rated structured finance CDOs: a preliminary review. Structured Finance Special Comment (23 March)

Nomura Securities (2004) The Bespoke [bispóuk] – a guide to single-tranche synthetic CDOs. Nomura Fixed Income Research (17 November)

Parker E (2007) Credit derivatives. Globe Law and Business, London

Chapter 22
Market Efficiency: Theory, Tests, and Applications

S.R. Vishwanath

22.1 Chapter Introduction and Objectives

Many finance theories and asset pricing theories are written under the assumption that markets are efficient. Consequently, the topic has attracted substantial scholarly interest. There are three types of market efficiency depending on what type of information is reflected in security prices.

Many academic studies have unearthed numerous anomalies in the US capital markets that seem to contradict market efficiency. Many of these anomalies seem to exist in other parts of the world as well. This chapter provides an overview of some of the anomalies and throws light on what, if at all, investors can do to exploit these anomalies.

> There is no other proposition in economics that has more solid empirical evidence supporting it than the Efficient Market Hypothesis .... In the literature of finance, accounting, and the economics of uncertainty, the EMH is accepted as a fact of life.
>
> Prof Michael C Jensen in "Some Anomalous Evidence Regarding Market Efficiency," Journal of Financial Economics 1978

> Prediction is very difficult, especially if it's about the future.
>
> Nils Bohr, Nobel laureate in Physics

> This message (that attempting to beat the market is futile) can never be sold on Wall Street because it is in effect telling stock analysts to drop dead.
>
> Prof Paul Samuelson, Nobel laureate in Economics

> I have personally tried to invest money, my client's money and my own, in every single anomaly and predictive device that academics have dreamed up .... I have attempted to

S.R. Vishwanath
Institute of Management Technology,
Nagpur, India
e-mail: srvishy@gamil.com

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_22,

> exploit the so called year-end anomalies and a whole variety of strategies supposedly documented by academic research. And I have yet to make a nickel on any these supposed market inefficiencies ... a true market inefficiency ought to be an exploitable opportunity. If there's nothing investors can exploit in a systematic way, time in and time out, then it is very hard to say that information is not being properly incorporated into stock prices.
>
> Prof Richard Roll, UCLA And Portfolio Manager

> It's just not true that you can't beat the market. Every year about one-third of the fund managers do it. Of course, each year it is a different group.
>
> Stovall, Robert, Investment Manager, ABC 20/20 Interview "Who Needs the Experts," 1992

Efficient Market Hypothesis states that all relevant information is fully and immediately reflected in a security's market price, thereby assuming that an investor will obtain an equilibrium rate of return. In other words, an investor should not expect to earn an abnormal return (above the market return) through either technical analysis (usage of past stock price patterns to predict future) or fundamental analysis. It implies that if new information is revealed about a firm it will be incorporated into the share price rapidly and rationally, with respect to the direction of the share price movement and the size of that movement. In an efficient market no trader will be presented with an opportunity for making a return on a share (or other security) that is greater than a fair return for the risk associated with that share (or any other security). The absence of abnormal profit possibilities arises because current and past information is immediately reflected in current prices. It is only new information, which causes prices to change. In the major stock markets of the world, prices are set by forces of supply and demand. There are hundreds of analysts and thousands of traders receiving new information on a company through electronic and paper media. The moment an unexpected, positive piece of information leaks out, investors will act and prices will rise rapidly to a level that gives no opportunity to make further profit.

22.2 Types of Market Efficiency

Depending on which information is reflected in stock prices there are three types of market efficiency.

Under *weak form efficiency*, the current stock price reflects the information contained in all past prices, which means that charts and technical analyses that use past prices alone would not be useful in finding under valued stocks.

Under *semi-strong form efficiency*, the current stock price reflects the information contained not only in past prices but all public information (including financial statements, news, and analyst reports) and use of this information would not be useful in finding under valued stocks.

Under *strong form efficiency*, the current price reflects all information, public as well as private, and no investors will be able to consistently find under valued stocks.

22.3 Information Arrival and Price Updates: Event Studies

The efficient market theory states that security prices reflect all currently available information. How does the market adjust to the arrival of new information? Event study methodology is one such tool to measure the economic impact of events.

An event study, in economics, finance, and accounting research, is an analysis of whether there was a statistically significant reaction in financial markets to past occurrences of a given type of event that is hypothesized to affect public firms' market values.[1] That is, event studies examine the effect of some event or set of events on the value of assets. Examples include the effect of stock splits or dividend changes or stock issuance on stock prices of firms.

The event that affects a firm's market value may be within the firm's control (e.g., the event of the announcement of a stock split, mergers and acquisitions, earnings announcements, issue of new debt or equity) or the event may be outside the firm's control (e.g., the event of a legislative act being passed, or a regulatory ruling). Examples include pollution regulation or corporate governance acts, such as Sarbanes Oxley or anti-trust rulings or sudden CEO deaths being announced, that will affect the firm's future operations in some way. Announcements of macroeconomic variables also come under this category.

Event studies have become a standard tool for testing semi-strong form market efficiency. A classic event study by Fama, Fischer, Jensen, and Roll examined the impact of stock splits (Fama et al. 1969). They found that abnormal returns dissipated rapidly following the news of stock splits, thus supporting the efficient market hypothesis.

22.3.1 Performing an Event Study

The following steps are followed for conducting an event study of a firm-specific event.

- Identify the event and the timing of its occurrence (i.e., a list of firms and dates, perhaps by running a literature search to find news announcements)

The event to be studied has to be clearly defined and the date on which the event was announced identified

- Collect security price performance data (i.e., stock returns) for each of the firms in the sample around these dates (i.e., look up stock price changes for those firms in periods around those dates in Datastream, and also changes in a market-wide index in the same periods by, e.g., collecting this data from databases such as the CRSP database of daily stock market returns for US firms).

[1] The pioneering works on event studies and econometrics of financial markets are Brown and Warner, 1985, Campbell et al. 1997. Other non-technical references include Kritzman 1994 and MacKinlay 1997.

In doing so one has to choose the return interval (i.e., whether to collect daily, weekly, or shorter interval returns as well as the time period over which the study will be conducted). That is, one has to set an event window. For example, one may choose to study the price performance over 90 days preceding the event, the event date, and 10 days following the event. This is shown in a time line diagram below:

The entire time line is the event window. In the above example stock returns are gathered for 101 days in all.

- Adjust for market performance and risk

That is, separate the security-specific component of return from the security's total return during the pre-event measurement period. The returns around the announcement date are adjusted for market performance and risk to arrive at excess returns for each firm in the sample. If the capital asset pricing model were to be used,

$$\text{Excess Return on day } t = \text{Return on day } t - \text{Beta} \times \text{Return on market on day } t$$

The standard practice is to use the *market model* to isolate specific return. Each security's daily returns during the pre-event measurement period from T-90 through T-1 are regressed on the market's returns during the period. The security-specific returns are defined as the differences between the security's daily returns and the daily returns predicted by the regression equation (the security's alpha plus its beta times the market's daily returns)

$$\text{Security-specific returns} = \mathrm{ER}_{i,\,t} = \mathrm{R}_{i,\,t} - \acute{\alpha}_i - \beta_i\,(\mathrm{R}_{m,\,t})$$

Where

$\mathrm{R}_{i,t}$ = total return of security i in period t
$\acute{\alpha}_i$ = alpha of security i estimated from pre-measurement period
β_i = beta of security i estimated from pre-event measurement period
$\mathrm{R}_{m,t}$ = total return of market in period t

- Compute the cross-sectional average for the pre-event measurement period

Take an average of excess returns for all firms in the sample on a daily basis and calculate the standard error during the pre-event measurement period from T-90 through T-1.

$$\text{Average excess return on day } t = \frac{\sum \mathrm{ER}_{i,\,t}}{N}$$

Where N is the number of events in the event study

- Calculate the security-specific return during the event and post-event periods

The procedure to estimate the security-specific return is same as above mentioned. The alphas and betas used in the market model are the same as those estimated from the pre-event regressions. The time period ranges from 0 to +10.

- Compute the cross-sectional average for the event and post-event period (i.e., T through T + 10) and find the standard error using the procedure described above
- Estimate the statistical significance

The question of whether the excess returns around the announcement are different from zero is answered by estimating the t-statistic for each *n*, by dividing the average excess return by the standard error.

$$\text{t-statistic} = \frac{\text{Average excess return across all securities}}{\text{standard deviations across all securities}}$$

$$\text{t-statistic for excess return on day } t = \frac{\text{Average excess return}}{\text{Standard error}}$$

If the t-statistics are statistically significant, the event affects returns; the sign of the excess return determines whether the effect is positive or negative and we conclude that the market is inefficient (i.e., it does not quickly absorb new information) if we were to observe significant t-statistics on the post-event days.

22.3.2 Testing Weak Form Efficiency

Weak form efficiency should be the simplest type of efficiency to prove, and for a time it was widely accepted that the US stock market was at least weak form efficient. The weak form efficiency requires that one cannot make money using past price history of a stock (or index) to make excess profits. In other words, technical charting is useless. Numerous studies of the ability of technical trading rules suggest that it is difficult to exploit short-term patterns to make money.

Interestingly, as you increase the *horizon* of the return, there seems to be evidence of profits through trading.[2]

22.3.3 Anomalies

Despite strong evidence that the stock market is highly efficient, there have been scores of studies that have documented long-term historical anomalies in the US stock market that seem to contradict the efficient market hypothesis. While the existence of these anomalies is well accepted, the question of whether investors can

[2] See the section on short-term momentum and long-term reversal.

exploit them to earn superior returns in the future is subject to debate. Investors evaluating anomalies should keep in mind that although they have existed historically, there is no guarantee they will persist in the future. If they do persist, transactions and hidden costs may prevent outperformance in the future. Investors should also consider tax effects in their taxable portfolios when evaluating stock strategies.

Unearthing an anomaly is one thing and actually making money out of it is another. It is common for money to flow into strategies that attempt to exploit anomalies and this in turn causes the anomaly to disappear. For example, there are several funds that invest only in small cap stocks. We would not expect them to make money (after adjusting for risk) consistently. Otherwise nobody would invest in large cap stocks. Further, even anomalies that do persist may take decades to pay off. Investors evaluating historical data should also consider the potential pitfalls of data mining. When searching large amounts of data, correlations between variables may occur randomly and therefore may have no predictive value. Anomalies that have existed over the longest time frames and have been confirmed to exist in international markets and out of sample periods are particularly persuasive.

In this section, we discuss the most prominent anomalies unearthed in the US capital markets and replicated the world over.

22.4 Predictable Patterns Based on Past Stock Prices

The first set of anomalies is patterns based on past stock prices. The random walk theory states that stock price changes have the same distribution and are independent of each other, so the past movement or trend of a stock price or market cannot be used to predict its future movement (Malkiel 1973; Fama 1970).

This is the idea that stocks take a random and unpredictable path. A follower of the random walk theory believes it is impossible to outperform the market without assuming additional risk. Critics of the theory, however, contend that stocks do maintain price trends over time. In other words, that it is possible to outperform the market by carefully selecting entry and exit points for equity investments. In this section, we review evidence on some prominent patterns in stock prices.

22.4.1 Short-Term Momentum and Long-Term Reversal

If markets are weak form efficient prior stock returns should have no relation to future stock returns. Academic studies have shown that prior stock returns have explanatory power in the cross-section of stock returns. Stocks that experience an increase in price over a period of 3–12 months are more likely to continue to do so over the subsequent 3–12 months. This phenomenon is referred to as momentum. Jegadeesh and Titman (1993) show that a strategy that involves simultaneously buying past winners and selling past losers generates significant abnormal returns over holding periods of 3–12 months. This abnormal profit cannot be accounted for by market, size, or value factors (the factors in CAPM and Fama-French models). Researchers attribute this profit to underreaction to news by market participants. If the full impact of an important news announcement is only grasped over a period of time, stock prices will exhibit serial correlation. But statistical significance is not the same as economic significance. Other studies have shown that momentum investors do not earn excess returns due to significant transaction costs.

Although there is positive serial correlation in the short run (when returns are measured over a period of days or weeks), academic studies have found negative serial correlation (i.e., return reversals) in the long run (93–7 years). That is, prices are mean reverting (DeBondt and Thaler 1989). This phenomenon is usually attributed to overreaction. Mean reversion has also been documented for non-US markets like Canada and the UK. Again mean reversion is consistent with market efficiency because they could result from volatility and mean reverting behavior of interest rates (interest rates and stock prices are negatively related).

22.4.2 Calendar Anomalies (Seasonal and Day of the Week Patterns)

A number of researchers have found that January has been an unusual month for stock market returns.[3] The "January effect" seems to be there in markets throughout the world. The January effect is particularly intriguing because it does not appear to be diminishing despite being well known and publicized for nearly two decades. Theoretically, an anomaly should disappear as traders attempt to take advantage of it in advance. Additionally, many have argued that some of the other anomalies (e.g., size) occur primarily or entirely during the month of January. In a seminal paper, Rozeff and Kinney (1976) found seasonal patterns in an equal weighted index of NYSE prices over the period 1904–1974. The average monthly return in January was about 3.5%, while other months averaged about 0.5%. Over one-third of annual returns occurred in January alone.

The effect is usually attributed to small stocks rebounding following year-end tax selling (Haug and Hirschey 2006). Individual stocks depressed near year-end are more likely to be sold for tax-loss recognition while stocks that have run up are often held until after the new year. The problem with this pattern is that they are not dependable from period to period. Some believe the January effect has moved into November and December as a result of mutual funds being required to report holdings at the end of October and from investors buying in anticipation of gains in January.

Some studies of foreign countries have found that returns in January were greater than the average return for the whole year.[4] Interestingly, the January effect has also been observed in many foreign countries including some (Great Britain and

[3] The January Effect was first documented by Haugen and Lakonishok (1988).

[4] See Hawawni and Keim (1995) for a worldwide evidence.

Australia) that do not use December 31 as the tax year-end. This implies that there is more to the January effect than just tax effects.

Some researchers have documented (negative or) lower closing returns on Mondays compared to other days. This is contrary to what we would expect. There are three days between close of trading on Friday and close of trading on Monday. During this period we would expect more information to flow into the market and hence result in higher price rise than other days. One study suggests that the "Monday effect" is essentially a "weekend effect" in the sense that the negative returns were all between the close of trading on Friday and the opening on Monday and prices actually rose between Monday morning and close of trading on Monday.

There appears to similar patterns on days before holidays, the first half of the month, and end-of-the-day.[5]

22.5 Predictable Patterns Based on Valuation Ratios

As pointed out in the chapter on valuation using multiples, considerable empirical research has been done to determine if future stock returns can be predicted on the basis of initial valuation parameters like dividend yield and price-earnings multiple of the stock market as a whole.

Academic studies of the ability of dividend yields to forecast future returns have been conducted by Fama and French (1988) and Campbell and Shiller (1988). These studies find that as much as 40% of the variance of future returns for the stock market as a whole can be predicted on the basis of the initial dividend yield on the index.

While it is probably true that investors have earned a higher rate of return when they purchased a market basket at a relatively higher initial dividend yield and lower future returns when they purchased a market basket at a relatively lower initial dividend yield, this strategy may not work well in future because recent academic studies find that firms now are more inclined toward repurchasing stock rather than paying dividends. So, strategies involving dividend yields are not likely to be meaningful in future.

Further, within the past 20 years there have been periods in which the "Dogs of the Dow" investment technique has under performed the Dow as a whole. An investor should be aware that this is a long-term investment strategy and no one should expect the Dogs to outperform the Dow each and every year. Also, the mutual funds that employ the "Dogs of the Dow" strategy underperformed the market averages during 1995–1999.

Investors can also construct trading strategies on the basis of P/E multiple. Academic studies conducted in the United States have found that investors have tended to earn larger long-horizon returns when purchasing the market basket of stocks at relatively low P/E multiples. Campbell and Shiller (1988) report that initial P/E ratios explained as much as 30% of variance of future returns.

[5] Interested readers may refer to Ariel (1990), Thaler (1987b), and French (1980).

This evidence of stock market predictability should not be interpreted as a challenge to the view that markets are efficient. These works do *not* demonstrate that exploitable arbitrage opportunities exist that would enable investors to earn excess risk-adjusted return (Malkiel 2004).

22.6 Predictable Patterns Based on Firm Characteristics

A number of predictable patterns are based on firm characteristics like size and valuation parameters like Book-to-market ratio. Recollect from the chapter on CAPM that researchers like Fama and French have pointed out that beta alone does not fully account for cross-sectional differences in stock returns. Other firm-specific factors like market capitalization have more predictive ability than beta. In this section, we review some of the evidence relating to size, value, and equity premium puzzles.

22.6.1 The Size Effect

Market capitalization refers to the total value the market puts on a company. It is calculated by multiplying the price of a stock by its total number of shares. Many studies have shown that small firms (capitalization or assets) tend to outperform large ones. The Russell 2000 index (small cap stocks) outperformed the S&P 500 index by 9.73% in 2006 and has slightly outperformed the S&P 500 over the past 27 years.

The small stock affect was first documented by Rolf W. Banz. He divided the stocks on the NYSE into quintiles based on market capitalization. The returns from 1926 to 1980 for the smallest quintile outperformed the other quintiles and other indexes. Other studies have argued that it is not the size that matters, but it is the attention and number of analysts that follow the stock. The Size Effect is subject to intense debate over whether an opportunity to generate excess returns actually exists, or that it is not reasonable to assume that investors can realize those returns. Two problems with the Banz study were pointed out by David Dreman in his book *Contrarian Investment Strategies: The Next Generation*.

- Small stocks typically have large spreads and commissions and cannot be bought by institutional managers without significantly moving the share price. Therefore, even so-called "small company" funds have difficulty taking advantage of small capitalization stocks. From 1931 to 1935 the median bid-ask spread for large cap stocks in the study was 1.3%, while the median bid-ask spread for small cap stocks was 20%. This implies that investors could not have achieved the returns calculated by Banz of investing in small cap stocks in this period. During these five years small cap stocks returned 15.0% per year while large cap stocks returned 3.1% per year. From 1941 to 1945 the median bid ask spread was still 17 and 37% of the companies in the small stock group did not trade on

any given trading day. During these five years small cap stocks returned 45.9% per year while large cap stocks returned 17.0% per year. Without these two time periods, small cap stocks would not have outperformed large cap stocks over the whole period of study.
- Survivorship bias may have existed in the sample. In effect, it is hard to track down the returns of small stocks from the 1920s to 1940s that subsequently went bankrupt, and it is therefore likely that the negative returns of those stocks were omitted from the study.

Some argue that after accounting for commissions when buying small stocks, there is no advantage. Some practitioners point out that the Banz study deals only with stocks from the NYSE which are larger than small stocks from other exchanges. Further, they also state that much of the data is based on stocks that traded thinly or not at all, the point being that you could not really buy them in large quantities if at all at their quoted price. On the impact of trading costs and liquidity on the analysis of small cap performance, Marc Reinganum commented that "Several academic papers have been written on this topic, and depending upon whose you read, some have negated the fact that a small cap effect exists. Others support the notion that, even taking the transaction costs into account, small caps carry some premium. The answer depends on how the studies are structured" (Reinganum 1997).

Professor Jeremy Siegel of Wharton argues that the period from the end of 1974 through the end of 1983 accounts for the whole outperformance of small caps.[6]

The size effect has been reproduced for numerous sample periods and for most major securities markets around the world.[7]

22.6.2 Value Effect

Like the size effect there is also a "value effect" in the US capital markets. A classic study on the performance of low price-to-book value stocks was by Eugene Fama and Kenneth French. It covered the period from 1963 to 1990 and included nearly all the stocks on the NYSE, AMEX, and NASDAQ. The stocks were divided into ten groups by book/market ratio and were re-ranked annually. The lowest book/market stocks outperformed the highest book/market stocks 21.4 to 8% with each decile performing worse than the previous. Fama and French also ranked the deciles by beta and found that the value stocks had lower risk and the growth stocks had the highest risk. The study had a profound impact in the academic community and made headlines. Some researchers now believe that "value" represents a risk factor that investors are compensated for. The argument is that value stocks are risky because they are down-and-out and in danger of getting worse and therefore investors need to be compensated with higher returns in exchange for accepting the

[6] See www.jeremysiegel.com for his articles and books. In particular, his book - Stocks for the Long Run (McGraw Hill 2002) is widely acclaimed.

[7] Hawawni and Keim (2000).

risk of investing in value stocks. In another study, James Davis, Fama, and French document the performance of low price to book value stocks in the out of sample period from 1929 to 1963 (Davis et al. 2000). This study discusses the explanations for the value premium.

In a study of the largest 1,500 stocks on Compustat for the 25 years ended 1994, David Dreman, author of the book Contrarian Investment Strategies, found that the 20% lowest P/B stocks (quarterly adjustments) significantly outperformed the market which outperformed the 20% highest P/B.

Others argue against the notion that value is a risk factor. Schwert (2001) points out that Dimensional Fund Advisors, a fund that selects value stocks (and small cap) according to the Fama-French criteria, actually generated −0.2% (after adjusting for beta) per month for the period 1993–1998, which suggests that the value premium is not pervasive.

Interestingly, numerous studies of foreign stock markets have come to similar conclusions regarding growth and value stocks. The implication is that investors worldwide systematically misprice value stocks. Fama and French (1998) found that value stocks have higher returns than growth stocks in markets around the world. For 1975–1995 the difference between the average returns on global portfolios of high and low book-to-market stocks is 7.60% per year, and value stocks outperform growth stocks in 12 of 13 major markets (United States, Japan, UK, France, Germany, Italy, Netherlands, Belgium, Switzerland, Sweden, Australia, Hong Kong, and Singapore) (Fama and French 1998).

Carlo Capaul, Ian Rowley, and William Sharpe studied six countries from January 1981 through June 1992 and found that Value Stocks outperformed growth stocks on average in each country. John R. Chisolm studied stocks in France, Germany, Japan, and the United Kingdom from 1974 through 1989. Stocks were divided into quintiles based on price to book value and adjusted annually. In each country the low price to book value quintile outperformed. The difference in annual compound returns in France and Japan was more than 10% for the period studied. Chisolm also divided stocks into quintiles based on P/E and found similar results with low P/E stocks outperforming, particular in the United Kingdom. Michael Keppler studied the performance of 18 country indexes from 1969 through 1989. The indexes were grouped into quartiles based on dividend yield and adjusted quarterly. In both local currencies and dollars, the most profitable strategy would have been to own the highest yielding quartile of indexes.

22.6.3 The Equity Risk Premium Puzzle

Exhibit 22.1 shows historical returns and the historical risk premium (on a compounded and an arithmetic basis) for the US markets from 1802–1998. The equity risk premium is based on a comparison with US T-Bonds and US T-Bills. As the table shows, on an average, stocks earned 4.7% more than T-Bonds and 5.5% more than T-Bills during the period 1802–1998. The existence of such a large premium has been used to suggest that markets are less than fully rational because this seems

Exhibit 22.1 Equity premiums (%) – U.S. data, 1802–1998

	Equity premium with bonds		Equity premium with bills	
	Geometric	Arithmetic	Geometric	Arithmetic
1802–1998	3.5	4.7	5.1	5.5
1802–1870	2.2	3.2	1.9	2.9
1871–1925	2.9	4.0	3.4	4.6
1926–1998	5.2	6.7	6.7	8.6
1946–1998	6.5	7.3	7.2	8.6

Source: Jeremy Siegel (1999)

Market risk premium 1985–2006

	Geometric mean returns (%)	Arithmetic mean returns (%)
Market return	13.13	14.39
T Bond Return	9.12	9.57
Market Risk Premium	4.01	4.82

to be inconsistent with the risk of common stocks as can be measured statistically. This phenomenon is termed "equity premium puzzle" (Mehra and Prescott 1985; Siegel and Thaler 1997).

Over the period 1927–2005 the average equity risk premium is 0.645 per month. Utility-based asset pricing models have difficulty explaining an equity premium of this magnitude – either because the return on treasury bonds are too low or because the return on equities are too high. Although the long-term return on equity indexes has been 7%, the return equity holders realize is not 7% due to transaction costs (to build up a portfolio) and lack of diversification (Siegel 1999). So realized real returns have been lower (say, 5–6%). Assuming 3.5% real return on bonds, the equity premium would be in the range of 1.5–2.5%.

22.7 Returns to Different Types of Investors

One of the implications of the efficient market hypothesis is that lay investors should be able to earn normal rates of return because it would be as hard to identify stocks that are likely to underperform as it would be to identify stocks that are likely to outperform. Those who trade too much would incur unnecessary transaction costs and reduce the rate of return. This has been confirmed by academic studies. Other studies of performance of professional money managers conclude that they do not systematically outperform a passive index fund strategy.

Active managers of equity funds underperform index funds when both are measured after expenses, and those that do outperform in one period are not typically the ones who outperform in the next. Likewise, bond funds underperform fixed income indexes by an amount equal to expense and there is no evidence that past performance can predict future performance.

One way to test the efficient market hypothesis is to compare the prices of assets to their intrinsic values (i.e., present values of expected future cash flows). Although it is, in general, difficult to estimate intrinsic values, there is one case where it is relatively easy to do so – the case of closed-end mutual funds.

A closed-end investment is an investment company that issues a fixed number of shares in an actively managed portfolio of securities. The shares are traded in the market just like common stock. Most mutual funds are open-end funds, not closed-end. The main difference with closed-end funds is that market price of the shares is determined by supply and demand and not by net-asset value (NAV). Any stockholder who wants to liquidate must sell the shares at the market price. Since the share price is determined by demand and supply it can diverge from net asset value. Funds selling for less than their NAV are said to trade at a discount and those selling for more are said to trade at a premium. Studies find that some funds trade at substantial discount whereas others trade at very high premium. This is inconsistent with the EMH (Lee et al. 1990).

22.7.1 Returns to Initial Public Offerings: The New Issues Puzzle

A number of studies have recorded widespread underpricing of initial public offerings. That is, IPOs produce abnormal returns (i.e., returns adjusted for market performance) on the day of listing. This phenomenon is not specific to the United States. Academic studies have documented similar results in many countries around the world. Exhibit 22.2 presents the result of one such study.

On the basis of these findings it seems one would do well to invest in IPOs and cash out after they get listed. The flip side is that some of them may turn out to be block busters in the long run (e.g., Microsoft). Further, retail investors may find it difficult to get allocation in hot issues.

Exhibit 22.2 IPO average initial return around the world

Country	Period	Average initial return %
Australia	1976–1995	12.1
Brazil	1979–1990	78.5
China	1990–2000	256.9
Denmark	1984–1998	5.4
France	1983–1998	9.5
Germany	1978–1999	27.7
Hong Kong	1980–1996	15.9
India	1992–1993	35.3
Korea	1980–1996	74.3
New Zealand	1979–1999	23.0
Philippines	1987–1997	22.7
Switzerland	1983–1989	35.8

Source: Loughran et al. (1994)

22.7.2 Long Run Returns to Firms Issuing Equity

Studies in America have shown that although there is short run underpricing, there is considerable overpricing in the long run and there is also evidence that secondary offerings also underperform in the long run. Over the 5-year period following the IPO, new issues produce significantly lower returns than similar public companies. Between 1970 and 1990, an average new issue in the United States produced annual returns of just 5% while investing an equal amount at the same time in a non-issuing firm would have produced an annual return of 12%.[8] Other studies have found that firms going public exhibit a substantial decline in post-issue operating performance. Over a six-year period extending from the year prior to the IPO until five years after the offering the performance of IPO firms declines significantly relative to their pre-IPO levels.[9] Exhibit 22.3 presents returns on IPOs in the long run in the United States. This pattern is not specific to America. Numerous studies replicated around the world confirm these findings.[10] A study by Tim Loughran and Jay Ritter discussed some of that research and present additional findings on both IPOs and secondary offerings (Loughran and Ritter 1995). The authors studied IPOs and seasoned equity offerings (SEO) from 1970 to 1990 and found that both underperformed REITS and ADRs. The authors concluded that "Our evidence is consistent with a market in which companies announce stock issues when their stock is grossly overvalued, the market does not revalue the stock appropriately, and the stock is still substantially overvalued when the issue occurs." Several recent studies have also documented arguably related market inefficiencies. Bala Dharan and David Ikenberry (Dharan and Ikenberry 1995) found that firms listing their stock on the NYSE and AMEX for the first time subsequently underperform.

Why are so many issues underpriced? Many plausible reasons have been suggested. The underwriter, because of his superior experience in marketing IPOs and knowledge of the market, can often coax an issuer to set a price low enough to sell

Exhibit 22.3 Returns on IPOs in the U.S during the five years after issuing, 1990–1998 (%)

	1st	2nd	3rd	4th	5th	Geo.Mean
IPO firms	14.9	12.0	11.5	24.2	9.9	14.4
Size-matched	14.8	16.6	13.8	23.1	13.9	16.4
Difference	0.1	– 4.6	– 2.3	1.1	– 4.0	– 2.0
% returns on IPOs from 1970–2003 during the first five years after issuing						
IPO firms	6.7	5.3	10.3	18.7	13.2	10.7
Size matched	12.2	14.7	14.7	17.3	15.1	14.8
Difference	– 5.5	– 9.4	– 4.4	– 1.4	– 1.9	– 4.1

Source: Prof Jay Ritter, University of Florida

[8] Loughran and Ritter (1995).

[9] Jain and Kini (1994).

[10] See, for instance, Levis (1993).

the issue. This is obviously in the interest of the underwriter. But an underwriter's ability to set unduly low prices is limited by his desire to protect his reputation. Another explanation is based on information asymmetry between different groups of investors. If underwriters have no superior skills in accurately pricing all issues, we would expect some issues to be overpriced and some issues to be underpriced. If the informed investors were able to identify overpriced issues we would expect them to avoid such issues and invest only in underpriced issues. The uninformed group realizes the incentive faced by the informed group and demands a discount on *all* issues. Another plausible explanation for short run underpricing and long run overpricing is that analysts tracking IPOs are overly optimistic about the earnings potential of these companies and investors pay attention to analyst forecasts. A study by Rajan and Servaes (1997) suggests that analyst following is positively related to IPO underpricing and that analysts are overoptimistic about the growth performance and earnings of IPOs.

22.7.3 Other Anomalies: The Value Line Anomaly

Value Line is a service that ranks stocks from 1 to 5 for timeliness. As a group, each rating has historically outperformed the next lowest rated group (the ones have outperformed the twos, which outperformed the threes, etc.). The impressive performance of the rating system led many to refer to it as the "Value Line Anomaly" or the "Value Line Enigma."

In an article on the Value Line Enigma, Fischer Black, the inventor of the Black-Scholes option pricing formula, confessed that previously he had been a strong believer in the efficient market hypothesis and passive management. Yet his research of Value Line's rating system confirmed that the system did produce significant excess returns over a five-year period. Excess returns would have resulted even after taking two percentage points out for round trip transactions costs (turnover in the rankings is high) (Black 1973).

In an attempt to match the returns of the top rated stocks, Value line established a mutual fund. The results of the Value Line Centurion fund (which invested in 100 Group 1 stocks and the top 100 of 300 Group 2 stocks) may serve as an important lesson for investors. Not only did the real-money fund not keep pace with the paper returns from the top rated stocks (which continued to outperform on paper), it did not even outperform the market. On the other hand, Value Line continues to be one of the highest ranked newsletters which does account for costs.

From 1979 to 1991, the Value Line paper portfolio had an annualized return of 26.2%, but the real Value Line fund had an annualized return of only 16.1%. In other words, while Value Line seems to have an ability to pick stocks well, the paper returns were not realizable by the mutual fund (and likely Value Line subscribers) probably because Value Line's rankings are a prisoner of their own success. They work so well that too many people try to act on them (Leinweber 1995; Perold 1988).

22.8 Concluding Comments

The empirical tests of stock market anomalies rely on a joint null hypothesis that markets are informationally efficient *and* returns behave according to a pre-specified equilibrium model (e.g., CAPM). Thus even though anomalies are often interpreted as evidence of market inefficiency, such a conclusion is inappropriate because the rejection may be due to an incorrect equilibrium model (e.g., the CAPM). Some argue that the anomalies, once identified, will attract investors and hence, dissipate profit opportunities. While this is true of some anomalies, many still persist, which suggests that markets are probably not inefficient but our understanding of capital asset pricing is incomplete. Further, serial correlation may be the result of time varying risk free rates and market risk premiums.

Numerous event studies of stock market reaction to a host of corporate actions have been conducted in the last two decades. Many have also examined long run performance. Exhibit 22.4 summarizes the results of findings for a variety of events.

22.9 End of the Chapter Questions

1. Define market efficiency.
2. What are the types of market efficiency?
3. Explain the procedure involved in testing weak form and semi-strong form market efficiency.
4. Describe event studies.
5. Describe the predictable patterns on the basis of past stock prices and valuation ratios.

Exhibit 22.4 Signs of long-term pre-event, announcement and long-term post-event returns for various long term studies

Event	Long term pre-event return	Announcement return	Long-term post-event return
IPO	N.A	+	–
Seasoned equity	+	–	–
Mergers (acquiring firm)	+	0	–
Dividend initiations	+	+	+
Dividend omissions	–	–	–
Earnings announcements	N A	+	+
Share repurchases (Open market)	0	+	+
Share repurchases (Tender)	0	+	+
Proxy fights	–	+	– or 0
Stock splits	+	+	+
Spin offs	+	+	+ or 0

Source: Fama (1998)

6. What is the size effect and what could be its source?
7. What is the equity premium puzzle?
8. Summarize the evidence on IPO performance.

References

Ariel R (1990) High stock returns before holidays: existence and evidence on possible causes. J Finance 45(5)

Armitage S (1995) Event study methods and evidence on their performance. J Econ Surv 8(4): 25–52

Ball C, Torous W (1988) Investigating security price performance in the presence of event date uncertainty. J Financial Econ 22:123–154

Banz R (1981) The relationship between return and market value of common stock. J Financial Econ 9:3–18

Black F (1973) Yes, Virginia, there is hope: tests of the value line ranking system. Financial Anal J Sep–Oct

Boehmer E, Musumeci J, Poulsen A (1991) Event-study methodology under conditions of event-induced variance. J Financial Econ 30:253–272

Brock W, Lakonishok J, LeBaron B (1992) Simple technical trading rules and the stochastic properties of stock returns. J Finance 47

Brown S, Warner J (1985) Using daily stock returns: the case of event studies. J Financial Econ 14:3–31

Campbell J, Lo A, MacKinlay C (1997) The econometrics of financial econometrics. Princeton University Press, Princeton, NJ

Campbell JY, Shiller RJ (1988) The Dividend–Price Ratio and Expectations of Future Dividends and Discount Factors. Review of Financial Studies, 1:195–228, Fall

Capaul C, Rowley I, Sharpe W (1993) International value and growth stock returns. Financial Anal J January/February

Chin KC, Chen N (1991) Structural and return characteristics of small and large firms. J Finance

Chisolm JR (1991) Quantitative applications for research analysts. Investing Worldwide II, Association for Investment Management and Research

Daniel K, Titman S (1999) Market efficiency in an irrational world. Financial Anal J Nov/Dec

Davis J, Fama E, French K (2000) Characteristics, covariances, and average returns: 1929–1997. J Finance 55(1)

Dimson E, Mussavian M (1988) A brief history of market efficiency. Eur Financial Manage 4(1)

DeBondt W, Thaler R (1985) Does the stock market overreact? J Finance 40

DeBondt W, Thaler R (1989) A mean reverting walk down wall street. J Econ Perspect 3(1)

Dharan B, Ikenberry D (1995) The long-run negative drift of post-listing stock returns. J Finance

Fama E (1970) Efficient capital markets: a review of theory and empirical work. J Finance 25(2)

Fama E (1991) Efficient capital markets II. J Finance 46

Fama E (1998) Market efficiency, long-term returns and behavioral finance. J Financial Econ 49(3)

Fama E, Fischer L, Jensen M, Roll R (1969) The adjustment of stock prices to new information. Int Econ Rev 10(1)

Fama E, French K (1992) The cross-section of expected stock returns. J Finance

Fama E, French KR (1988) Dividend Yields and Expected Stock Returns. J Financial Econ, 22 (October), 3–25

Fama EF, French KR (1998) Value versus growth: the international evidence. J Finance 53(6)

French KR (1980) Stock returns and the weekend effect. J Financial Econ, 8(1), 55–69

Haug M, Hirschey M (2006) The January effect. Financial Anal J 62(5)

Haugen RA, Lakonishok J (1987) The incredible January effect. Dow Jones Irwin

Haugen R, Lakonishok J (1988) The incredible January effect, Dow Jones-Irwin, Homewood
Hawawini G, and Keim D (1995) On the Predictability of Common Stock Returns: World-Wide Evidence, in Jarrow, R.A., V. Maksimovic, and W.T. Ziemba, eds., Finance (North Holland)
Hawawini G, Keim D (2000) The Cross Section of Common Stock Returns: A Synthesis of the Evidence and Explanations: in Security Market Imperfections in Worldwide Equity Markets, edited by W.T. Ziemba and D. Keim: Cambridge University Press
Jain BA and Kini O (1994) The Post-Issue Operating Performance of IPO Firms. J Finance, 49
Jegadeesh N, Titman S (1993) Returns to buying winners and selling losers: implications for market efficiency. J Finance 48
Kato K, Schallheim J (1985) Seasonal and size anomalies in the Japanese Stock market. J Financial Quant Anal
Keppler AM (1991) The importance of dividend yields in country selection. J Portfolio Manage
Kothari SP, Warner J (2005) Econometrics of event Studies. In: Handbook of corporate finance: empirical corporate finance. Espen Eckbo, North Holland
Kritzman M (1994) What Practitioners need to know about event studies. Financial Anal J Nov/Dec
Lakonishok J, Vishny R, Shleifer A (1994) Contrarian investment, extrapolation and risk. J Finance
Lamont O, Thaler R (2003) The law of one price in financial markets. J Econ Perspect 17(4)
Levis M (1993) The long-run performance of initial public offerings: The U.K Experience 1980–88, Financial Management, 22, Spring
Lee C, Shleifer A, Thaler R (1990) Anomalies: closed-end mutual funds. J Econ Perspect 4(4)
Leinweber D (1995) Using information from trading in trading portfolio management. J Invest
Lo A, Mackinlay C (1988) Stock market prices do not follow random walks: Evidence from a simple specification test. Rev Financial Stud 1
Loughran T, Ritter J (1995) The new issues puzzle. J Finance 50(1)
Loughran T, Ritter J, Rydqvist K (1994) Initial public offerings: international insights. Pacific Basin J 2(2–3):165–199
MacKinlay AC (1997) Event studies in economics and finance. J Econ Lit
Madhavan A (2002) Market microstructure: a practitioners guide. Financial Anal J
Malkiel B (1973) A random walk down wall street. W. W. Norton, New York
Malkiel B (2003) The efficient market hypothesis and its critics. J Econ Perspect 17(1)
Malkiel B (2004) Models of stock market predictability. J Financial Res
McWilliams A, Siegel D (1997) Event studies in management research: theoretical and empirical issues. Acad Manage J 40
Mehra R, Prescott E (1985) The equity premium: a puzzle. J Monet Econ 15
Prabhala NR (1997) Conditional methods in event-studies and an equilibrium justification for standard event-study procedures. Rev Financial Stud 10(1):1–38
Perold AF (1988) The implementation shortfall: paper vs. reality. J Portfolio Manage 14(3):4–9
Rajan R, Servaes H (1997) Analyst Following of Initial Public Offerings. J Finance, 52
Reinganum M (1997) The size effect: evidence and potential explanations. Investing in Small-Cap and Microcap Securities, Association for Investment Management and Research
Roll R, Shiller R (1992) Comments: symposium on volatility in US and Japanese stock markets. J Appl Corp Finance 5(1)
Rozeff M, Kinney W (1976) Capital market seasonality: the case of stock returns. J Financial Econ 3
Rubinstein M (2001) Rational markets: yes or no? the affirmative case. Financial Anal J
Salinger M (1992) Standard errors in event studies. J Financial Quant Anal 27(1)
Schwert W (2001) Anomalies and market efficiency. In: Constantinides G et al (eds) Handbook of economics. North Holland, Amsterdam
Siegel J (1999) The shrinking equity premium. J Portfolio Manage
Siegel J, Thaler R (1997) Anomalies: the equity premium puzzle. J Econ Perspect 11(1)
Shiller R (2003) From efficient markets theory to behavioral finance. J Econ Perspect 17(1)
Thaler R (1987a) Anomalies: the january effect. J Econ Perspect 1(1)
Thaler R (1987b) Anomalies: seasonal movements in security prices II: weekend, holiday, turn of the month and Intraday effects. J Econ Perspect 1(2)

Thaler R (1988) Anomalies: the winner's curse. J Econ Perspect 2(1)
Thompson R (1985) Conditioning the return-generating process on firm specific events: a discussion of event study methods. J Financial Quant Anal 20
Thompson R (1995) Empirical methods of event studies in corporate finance, In: Jarrow R et al (eds) Handbooks in OR & MS, vol. 9, Chap. 29. Elsevier, Amsterdam

Chapter 23
An Overview of Mutual Funds and Exchange Traded Funds

S.R. Vishwanath and Chandrasekhar Krishnamurti

23.1 Chapter Introduction and Objectives

It is now common in most parts of the world for investors to invest through mutual funds that pool in money from investors and invest on their behalf. The global asset management industry has grown to $ 55 trillion. This chapter provides an overview of the types of schemes available to investors. We also compare mutual funds with another type of funds called exchange traded funds.

This chapter has the following objectives:

- Provide an overview of the types of schemes of mutual funds
- Compare exchange traded funds with mutual funds
- List out the advantages and disadvantages of exchange traded funds vis-à-vis mutual funds

Mutual funds offer individual investor an opportunity to diversify investment and provide professional money management often with affordable minimum investment amounts. A mutual fund is a security that pools money from investors to purchase stocks, bonds, or other securities for its portfolio. As a result, investors then typically own a portion of a portfolio that includes many more stocks and bonds than they could afford to purchase individually. Investors purchase shares of the portfolio – the value of which increase or decrease based on the value of the investments it holds. The fund distributes any income it receives from stock dividends or bond interest to the shareholders, along with any capital gains from the sale of securities. A diversified portfolio with a variety of investments may reduce the impact of

S.R. Vishwanath (✉)
Institute of Management Technology, 603, Khullar Apartments, Byramji Town, Nagpur 440001, India
e-mail: srvishy@gmail.com

C. Krishnamurti
AUT University College of Business, WF Building, Wellesley Campus, 42 Wakefield Street, Auckland 1010, New Zealand
e-mail: Chandrasekhar.krishnamurti@aut.ac.nz

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_23,

one poor performing investment by offsetting it with another that may perform well during the same time period. Therefore, the overall performance of the investments in a mutual fund's portfolio has the potential to provide better returns over the long term. Net new cash flow to stock and hybrid funds was $ 221 billion and investors also reinvested $ 42 billion of dividends in their stock and hybrid funds in 2004 in the United States. Individual investors, directly or indirectly, hold 90% of overall US mutual fund assets, and an even larger share of stock, bond, and hybrid fund assets. In 2004, individuals continued to use funds as one of their primary means to invest. For example, households made $ 360 billion in net purchases of stocks, bonds, and other long-term financial assets during the year, and long-term mutual funds were the principal means of making these purchases.

Assets of the global fund management industry increased for the third year running in 2006 to reach a record $ 55.0 trillion. This was up 10% on the previous year and 54% on 2002. Growth during the past three years has been due to an increase in capital inflows and strong performance of equity markets. Pension assets totaled $ 20.6 trillion in 2005, with a further $ 16.6 trillion invested in insurance funds and $ 17.8 trillion in mutual funds. Merrill Lynch also estimates the value of private wealth at $ 33.3 trillion of which about a third was incorporated in other forms of conventional investment management. The United States was by far the largest source of funds under management in 2005 with 48% of the world total. It was followed by Japan with 11% and the UK with 7%. The Asia-Pacific region has shown the strongest growth in recent years. Countries such as China and India offer huge potential and many companies are showing an increased focus in this region. Exhibits 23.1 and 23.2 present the statistics on the worldwide mutual fund industry and league tables in 2006.

23.2 Open-End Versus Closed-End Mutual Funds

Most mutual funds are *open-end funds*, which sells new shares continuously or buys them back from the shareholder (redeems them), dealing directly with the investor (no-load funds) or through broker-dealers, who receive the sales load of a buy or

Exhibit 23.1 Sources of global assets under management ($b, 2005)

Country	Conventional investment management pensions, insurance, mutual funds
US	26,489
Japan	6,153
UK	4,061
France	3,055
Germany	1,781
Netherlands	1,172
Switzerland	923
Other	11,316
Total	54,950

Source: Fund Management City Business Series, August 2006

Exhibit 23.2 Top ten asset managers by assets under management in 2005

Rank	Company	Asset under management ($m)	Country
1	Barclays Global Investors	1,400,491	U.K
2	State Street Global Advisors	1,367,269	US
3	Fidelity Investments	1,299,400	US
4	Capital Group companies	1,050,435	US
5	Legg Mason	891,400	US
6	The vanguard Group	852,200	US
7	Allianz Global Investors	790,513	Germany
8	J P Morgan Asset Mgt	782,646	US
9	Mellon Financial Corp	738,294	US
10	Deutsche Asset Mgt	723,366	Germany

Source: Global Investor

sell order. The purchase price is the net asset value at the end of the trading day, which is the total assets of the fund minus its liabilities divided by the number of shares outstanding for that day. The number of shares of an open-end fund varies throughout its existence, depending on how many shares are bought or redeemed by investors.

A major disadvantage to open-end funds is that they need cash to redeem their shares for investors who want out, so they either have to have a lot of cash on hand, which earns only the current prevailing interest rate, or have to sell securities to raise the cash, possibly generating capital gains taxes for the remaining investors of the fund.

A *closed-end mutual fund* sells shares of the fund in an initial public offering (IPO). After the offering, no more shares are created or redeemed. Therefore, less money is needed to manage the fund, since there is no need to deal directly with individual investors, such as sending periodic statements, and it also eliminates the need to redeem shares to pay investors who want to cash out, as is the case with open-end mutual funds. Consequently, a closed-end fund can be more fully invested, since it does not need as much cash, and it is more tax efficient.

The money from the IPO is used to buy a specific portfolio of securities that satisfies the advertised investment objective of the fund. Thereafter, shares of the company are bought and sold over a stock exchange or over-the-counter, just like any stock.

Because fund shares cannot be exchanged for the underlying securities that the shares represent an interest in, there is usually a large difference between the share price of the fund, and the net asset value (NAV) of the fund, which is the actual value of the securities represented by each mutual fund share. This results because the actual share price is determined by the supply and demand for the shares, which usually results in a market price that is different from the fund's NAV. When a fund is first sold, the share price is often at a premium to the NAV, which is how the fund's sponsors make money in creating the fund, but eventually it drops to a discount, and

Exhibit 23.3 Closed-end funds; assets and number of funds by type of fund

Year	Total equity	Total bond	Total
Assets ($m)			
2001	31,075	110,175	141,250
2002	33,724	125,081	158,805
2003	52,295	161,794	214,089
2004	81,396	173,042	254,438
Number of funds			
2001	116	377	493
2002	123	422	545
2003	130	456	586
2004	157	463	620

Source: 2005 Investment Company fact book

remains there. If the fund's share price is higher than its underlying NAV, then the shares are said to be selling at a premium over their net asset value; if the price is lower, then the shares are selling at a discount from their net asset value.

Exhibit 23.3 presents the statistics on closed-end funds in the United States.

23.3 Salient Features of a Mutual Fund

When a mutual fund is created, the founders decide what market strategies to pursue and its investment objectives. A required prospectus is prepared for potential investors that details the company's objectives, expenses, fees, and management, so that an investor can make an informed decision about the mutual fund. When an investor buys the shares of the mutual fund, he becomes a shareholder of the company, with basically the same rights and privileges as a shareholder of any other company.

23.3.1 Prospectus

The Securities and Exchange Commission (SEC), for example, in the United States requires that mutual fund companies give each prospective investor a prospectus, which details investment objectives, management, portfolio holdings, performance, and fees. The prospectus has at least the following:

- Minimum investment, which can be as low as $ 250;
- Shareholder programs that explain what information is available and what the shareholder can do by mail, telephone, or Internet;

- The different mutual funds of differing investment objectives available at the company, and the different classes of shares that differ by fee amounts and when they are assessed;
- Fees and expenses;
- How to purchase and redeem shares;
- When the mutual fund has a performance history, that history will also be included in the prospectus.

23.3.2 Statement of Additional Information

Also known as Part B of the registration statement (in the United States), the statement of additional information explains a fund's operations in greater detail than the prospectus – including the fund's financial statements and details about the history of the fund, fund policies on borrowing and concentration, the identity of officers, directors, and persons who control the fund, investment advisory and other services, brokerage commissions, tax matters, and performance such as yield and average annual total return information.

Fees: There are numerous fees associated with specific activities, the total of which can vary from 0.5% to 8.5%, the legal maximum in the United States. Management fees are annual charges for administering the fund, which can vary from about 0.5% to 2%. Distribution and service fees cover marketing expenses to bring in new investors, and may be used to pay bonuses for employees. Redemption fees, sometimes referred to as a deferred sale load or back load fees, are assessed when shares of the fund are sold, to discourage frequent trading, unless the investor has held the shares for a minimum amount of time, specified in the prospectus. Reinvestment fees can be charged if the investor reinvests his profits in the fund. Exchange fees can be charged if an investor transfers his money from one fund to another within the same company.

No-load funds do not charge a front-end sales charge or a deferred sales charge. National Association of Security Dealers rules also require that the distribution and service fees not exceed 0.25% of the fund's average annual net assets in order to call itself a no load fund.

Classes of Mutual Fund Shares: Many mutual funds with sales loads offer more than one class of shares. Each class will have the same portfolio of securities, investment objectives, and policies, but each class will have different shareholder services and/or distribution arrangements with different fees and expenses. As a result, each class will likely have different performance results. A multi-class structure offers investors the ability to select a fee and expense structure that is most appropriate for their investment goals (including the time that they expect to remain invested in the fund). Given below are some key characteristics of the most common mutual fund share classes offered to individual investors.

Class A Shares typically impose a front-end sales load. They also tend to have a lower distribution and service fee and lower annual expenses than other mutual fund share classes. Some mutual funds reduce the front-end load as the size of your investment increases. If one is considering Class A shares, one must make sure to inquire about breakpoints, which are only available for Class A shares.[1]

Class B Shares do not have a front-end sales load, but have a 12b-1 fee and a contingent deferred sales load – a sales charge assessed when the shares are redeemed. This charge typically declines to 0 over a period of 6 to 8 years, and then is automatically converted to Class A shares with a lower fee.

Class C Shares might have a distribution and service fee, other annual expenses, and either a front- or back-end sales load. But the front- or back-end load for Class C shares tends to be lower than for Class A or Class B shares, respectively. Unlike Class B shares, Class C shares generally do not convert to another class. Class C shares tend to have higher annual expenses than either Class A or Class B shares. These shares would be more attractive to a short-term investor.

Given below is a hypothetical example of share classes that one would find in a prospectus:

Class A shares	
Initial sales charge	Up to 5.75% (reduced for purchases of $ 25,000 or more and eliminated for purchases of $ 1 m or more)
Distribution and service fees	Up to 0.25%
Dividends	Generally higher than other share classes
Purchase maximum	None
Conversion	None
Class B Shares	
Initial sales charge	None
D&S fees	1.00% annually
Dividends	Generally lower than A and F shares
Purchase maximum	$ 50,000
Conversion	Automatic conversion to A
Class C Shares	
Initial sales charge	None
D&S fees	1.00% annually
Dividends	Generally lower than other classes
Purchase maximum	$ 500,000
Conversion	Automatic conversion to F shares after 10 years
Class F shares	
Initial sales charge	None
D&S fees	0.25% annually
Dividends	Generally higher than B and C shares
Purchase maximum	None
Conversion	None

[1] A fund with a sales load will usually offer breakpoints in the sales load, where decreasing sales load ratios apply to larger purchases of Class A shares. Buying a number of shares that exceed a breakpoint will reduce the sales load percentage that would apply below the breakpoint. A fund does not have to offer breakpoints, but if they do, it must be disclosed in the prospectus.

Exhibit 23.4 US mutual fund industry total net assets, number of funds, number of share classes

Year	Total net assets	Number of funds	Number of share classes
2000	6,964.67	8,155	16,738
2001	6,974.95	8,305	18,023
2002	6,390.36	8,244	18,985
2003	7,414.40	8,126	19,319
2004	8,106.87	8,044	20,036

Source: 2005 Investment Company fact book

Exhibit 23.5 Annual fund operating expenses (deducted from fund assets)

	Class A (%)	Class B (%)	Class C (%)	Class F (%)
Management Fees	0.27	0.27	0.27	0.27
Distribution and service fees	0.23	1.00	1.00	0.25
Other expenses	0.10	0.12	0.20	0.18

Exhibit 23.4 presents statistics on the US mutual fund industry.

Expense Ratio: Operating expenses, such as management fees, distribution and service fees, and administrative fees, but not including transaction costs in the buying and selling of securities or fund shares (sales loads), can be summarized by the expense ratio:

$$\frac{\text{Total operating costs excluding shareholder costs}}{\text{Average net asset value}} = \text{Expense ratio}$$

The expense ratio typically ranges from 0.18% to 2.0%.

The expense ratio is an important metric when comparing funds, because it can make a significant difference over time. Any money paid for expenses is money that is not invested and earns no profit. High expenses are not proportional to better management. In fact, frequently, high-expense funds underperform index funds, which are minimally managed and have very low expense ratios. All fees must be disclosed in the prospectus as a fee table. Exhibit 23.5 presents the sample annual fund operating expenses for the three classes of shares.

23.4 The Organization of a Mutual Fund

A mutual fund is organized either as a corporation or as a business trust that sells its shares to investors. Mutual funds have officers and directors or trustees. In this way, mutual funds are like any other type of company, such as General Electric.

Unlike other companies, however, a mutual fund is typically externally managed: it is not an operating company and it has no employees in the traditional sense. Instead, a fund relies upon third parties or service providers, either affiliated organizations or independent contractors, to invest fund assets and carry out other business activities.

A fund's board of directors is elected by the fund's shareholders to govern the fund, and its role is primarily one of oversight. The board of directors typically is not involved in the day-to-day management affairs of the fund company. Instead, day-to-day management of the fund is handled by the fund's investment adviser or administrator pursuant to a contract with the fund, as well as by the fund's chief compliance officer, whose appointment must be approved by the board.

The investment adviser manages the fund's portfolio according to the objectives and policies described in the fund's prospectus. The principal underwriter sells fund shares, either directly to the public or through other firms like broker-dealers. The administrator oversees the performance of other companies that provide services to the fund and ensures that the fund's operations comply with federal requirements. The transfer agent executes shareholder transactions, maintains records of transactions and other shareholder account activity, and sends account statements and other documents to shareholders. The custodian holds the fund's assets, maintaining them separately to protect shareholder interests. The independent public accountant certifies the fund's financial statements.

The process of setting up a mutual fund is performed by the fund's sponsor, typically the fund investment adviser, administrator, or principal underwriter. It must also register the fund under state law as either a business trust or corporation. In addition, in order to sell its shares to the public, the fund must first register those shares with the SEC by filing a federal registration statement pursuant to the Securities Act of 1933, and make filings with each state in which the fund's shares will be offered.

23.5 Choosing a Mutual Fund

Different types of mutual funds help meet a variety of investment objectives. In order to select a fund one must consider the following:

- *Investment goal*: Are you saving for retirement or a child's education or a home purchase?
- *Time horizon*: Will you need to use this money in the next 6 months or 2 years or 20 years?
- *Dollar amount*: Do you have several thousand dollars to invest at one time or do you plan to invest just a few hundred dollars a month?
- *Risk tolerance*: How much fluctuation can you stomach in the price of your shares?

Most mutual funds focus their investments in stocks, bonds, cash equivalents, or a combination of the above. The composition of the fund holds depends upon the stated objective of the fund. For example a fund may concentrate on the following:

- Growth or value investments
- Fixed income securities with short- or long-term maturities
- Small-cap, mid-cap, or large-cap sized companies
- US companies or international companies

23.6 Asset Allocation and Investment Styles

There are several types of mutual funds that can be categorized by a variety of criteria including:

- *Investment objective*: What is the goal of the fund? To help preserve the money invested or to seek to generate income or to seek growth but with additional potential for risk?
- *Investment style*: Does the fund seek to invest in rapidly growing companies or to invest in those companies considered undervalued by the market? Does the fund hold only securities with long-term or short-term maturities? Does the fund invest in small, mid, or large cap companies?
- *Investment strategy*: Is the fund passively managed or actively managed? Does the fund invest in equities, bonds, cash equivalents, or a combination?
- *Geographic coverage*: Does the fund invest in domestic stocks or internationally?

Mutual funds are generally categorized according to risk and return as shown below.

Money market funds	Bond/ income	Growth and income	Growth	Global/ international
Low risk objective: Capital preservation				High risk Growth potential

Money market funds that invest in short-term paper issued by government and corporations fall at one end of the spectrum while International investments (especially emerging markets) fall at the other end.

The different types of funds are described below.

23.6.1 Money Market Mutual Funds

Money market funds are all no-load funds, and pay dividends daily, though they may only be credited monthly. Their income generally reflects short-term interest rates, because by law, their investments are restricted to certain high-quality, short-term investments issued by the government, corporations, and state and local governments. Net asset value (NAV) is maintained at about $ 1.00 per share, which is possible because these funds pay out all of their income as dividends. But the NAV may fall below $ 1.00 if the fund's investments perform poorly. Most of them have check-writing privileges, though there may be a minimum amount for the check. Taxable funds buy higher yielding short-term corporate or federal issues. Tax-free funds buy municipal debt.

Money market funds have low risks, but unlike money market bank accounts, money market mutual funds are neither insured nor guaranteed by the Federal Deposit Insurance Corporation. Historically, the returns for money market funds have been lower than for either bond or stock funds. That's why inflation risk – the risk that inflation will outpace and erode investment returns over time – is a risk with these funds. Capital losses have been rare, but are possible.

23.6.2 Bond Funds

Bond funds are based on bonds, but they have no maturity date and no guarantee of repayment of principal. Bond funds benefit investors because the initial investment is less than the minimum $ 5,000 or more for bonds, and, like other funds, it allows easier and greater diversification by having a collection of different bond types, such as investment-grade corporate, junk, government, sector, international, gold and precious metals, and other categories; and different bond maturities. Bond fund assets rose to $ 1.3 trillion in 2004 in the United States, with fund performance accounting for the slight growth in assets.

In some funds, management is free to change categories as the changing markets warrant.

Tip: When interest rates rise, the NAV of bond funds declines because bond prices decline as interest rates rise, and vice versa, and so goes the total return of the fund. Thus, a bad time to buy a bond fund is when interest rates are rising, and a good time to buy is when they are declining. Taxable funds buy corporate and federal bonds. Tax-free funds buy municipal bonds. No federal tax, and no state or local tax if investor lives in the municipality.

Although bond funds are generally safer than stock funds, they do have risks:

Credit risk is the risk that issuers whose bonds owned by a fund may fail to pay their debts. Such risk is inversely related to the credit rating of the issuer. Thus, there is virtually no credit risk with US Treasuries, little risk with investment-grade bonds, and great risk with junk bonds.

Interest-rate risk arises from the possibility that interest rates will rise, thereby decreasing the value of bonds in the secondary market. Such risk can even reduce the value of Treasury bonds. The longer the bond term, the greater is the risk. However, since interest rates do not vary that much, this risk is relatively small compared to the price swings of stocks.

Prepayment risk increases as interest rates decline, increasing the likelihood that the bond issuer will call the bond in early to issue new bonds at the lower prevailing interest rate. Although, like interest rate risk, this risk is minor, it will lessen a fund's future income, unless the company is willing to buy bonds with a higher credit risk.

23.6.3 Stock Funds

Although a stock fund's short-term value is volatile, because prices depend not only on the economy, but also on the underlying business, stocks usually outperform other types of investments over the long term. Different kinds of stocks are chosen for their risk and potential profit.

- *Income funds* invest in stocks that pay regular dividends.
- *Index funds* buys stocks in a particular index, with the proportion of each stock proportional to the weight of that stock in the index.
- *Blue-chip funds* provide income and relative safety compared to small-cap stocks.
- *Growth funds* have a greater chance of significant appreciation, because they are based on small-cap, undervalued, or out-of-favor companies.
- *Value funds* are based on companies that some believe are undervalued, and thus, have a greater appreciation potential and greater safety.
- *Cyclical funds* invest in stocks that rise and fall with the economic cycles. Some businesses are heavily dependent on discretionary spending, such as airlines and hotels. When the economy is strong, these businesses do better as more people spend money for luxury items, thus, their stocks rise; when the economy is weak, people cut back on spending that is not necessary, thus lessening the earnings of these businesses, and reducing their stock prices.
- *Sector funds* invest in a particular industry, such as the medical field or technology. The increased potential for returns is proportional to the increased risk that results from limited diversification in a volatile investment. Sector funds invest in a particular sector of the economy, such as health care or technology. Lack of diversification in other sectors can yield higher profits, but at a greater risk of losses. Precious metal funds invest in mines and bullion, which is generally more stable than the typical sector fund.
- *International Funds*: There are actually four different kinds of international funds.

  - Global Funds: Global funds invest both in the United States and in other countries, but most investments are usually in US companies.
  - Overseas Funds: Overseas funds invest only in other countries.
  - Regional Funds – Country Funds: Regional funds invest in a specific region of the world, such as Asia, Europe, or Latin America.
  - Country funds invest in a specific country. Regional and country funds can profit from fast-growing economies, such as India or China, but there is a currency exchange risk and political risk. If the dollar increases in value, the value and profit of a foreign investment will decrease, and vice versa. Political turmoil will decrease the value of any investment in that country by increasing risk and reducing demand for its equities.

- *Special Funds* – Index Funds, Tax-Free Funds, Sector Funds, Green Funds

  - Index funds buy stocks that compose a particular index, such as the S&P 500, and the number of each stock purchased is proportional to the weight of that stock in the index. Index funds are considered to be a good investment because few funds beat the indexes, and fees are minimal.
  - Tax-free funds invest in the bonds of state and municipalities, which are generally tax-free for residents. The rate of return is generally lower than taxable returns, and it is best for high-income people who live in high-tax states, such as California and New York. However, investment opportunities are limited.

  - Green funds invest in environmentally friendly companies. These funds are not tracked as a sector fund, nor do they generally do as well as other funds, because returns are not the only consideration.

- *Asset Allocation Funds*: Asset allocation funds give complete liberty to the investment adviser as to how the fund can be allocated among assets, such as money market funds, stocks, bonds, options, and tangible assets, such as precious metals or real estate. This gives the adviser the greatest freedom to respond to market conditions, and to develop a strategy for maximum profits.
- *Target-Date Funds*: Designed to build a retirement income, target-date mutual funds (also, life-cycle funds) are funds of funds – including stock, bond, real estate, and international funds – where the mix of funds becomes more conservative as the target date approaches. Some funds include international and real estate funds to provide diversification from stocks and bonds. The most popular target date currently is 2015–2029. Greater than 90% of these funds are in retirement accounts. More than 80% of the money in target-date funds is managed by three mutual-fund giants: Fidelity Investments, Vanguard Group, Inc., and T. Rowe Price Group, Inc. Some example asset mixes are as follows: Vanguard funds start with a 90% stock and 10% bonds mix; at the target date, the mix becomes 50%–50%. Barclays Life Path funds start with the same mix but end up with 35% stocks and 65% bonds at the target date. Details of any fund can be found in its prospectus. Expense ratios range from 0.21% of assets for *Vanguard Target Retirement 2035 Fund* to 1.25% or more, for other funds. Note that these expenses are to manage the target-date fund itself, and do not include the expense ratios of the underlying stock and bond funds.
- *Quant Funds*: The name *quant* comes from the root word of *quantitative*, which describes the primary method of quant funds used to generate profits: letting computers determine what stocks to buy and sell, and when, based on quantitative measures of desirable stock characteristics, such as price-to-earnings, price-to-book, price-to-sales, and other ratios. Computers are also programmed to look at fundamental values, risk potential, and momentum. Because computers – not managers – select the trades based on specific algorithms, emotion is not a factor, and expense ratios are typically less than 1%. Minimum investments are usually $ 2,500 or $ 3,000. Some examples of quant funds are the Schwab Core Equity and INTECH Risk-Managed Stock funds.
- *Absolute-Return Funds*: These funds, recently created as a new type, are being marketed as a way to earn what they are calling "absolute returns" – a marketing term, not a guarantee. The name probably stems from the fact that absolute numbers are always positive. Their goal is to produce positive returns every year, regardless of the financial markets, by using many of the techniques employed by hedge funds – investing in foreign currency and commodities in addition to buying stocks and bonds, and using options, swaps, arbitrage, and selling short, which are strategies for making money when the financial markets are declining. The drawback to this approach is that while these funds may do better in bear markets, and may, indeed, produce positive returns every year, they probably will not perform as well as other funds in a bull market because their use of opposing

strategies diminishes their returns. Some examples of absolute-return funds are Rydex Absolute Return Strategies A and Rydex Absolute Return Strategies H. Minimum investment is typically $ 25,000 or more.

- *Earnings-Momentum Funds*: Earnings-momentum, sometimes called profit-momentum, funds buy stocks of companies that are growing more rapidly than the market average, and that have a good earnings forecast by Wall Street analysts, which is often supplemented with the funds' in-house research. When a company ceases to have increasing earnings, it is sold by the funds, which increases turnover of the funds' portfolio, and increases expenses and taxes for the investor. Furthermore, because fast-growing companies are frequently concentrated in particular sectors, these funds are less diversified than most, and thus have more risk. However, when the stock market is rising, these funds tend to do best of all, but when the stock market drops, these funds drop more than most. Typical examples include American Century Vista, which buys mid-cap growth stocks, and N/I Numeric Investors Emerging Growth, which emphasizes small growth companies.
- *Qualified Dividend-Paying Stock Funds*: Dividend-paying stocks generally do not yield as much as bond funds, but they do have a greater potential for capital appreciation, and with qualified dividends, the top tax rate for the dividend income is 15% for most investors, and only 5% for people in the two lowest tax brackets. As an example, *Goldman Sachs Growth and Income Fund* is currently yielding about 1.5%, but its gains, with stock appreciation, through October 31, 2006 is 17.84%. Because funds of other countries pay higher dividends than in the United States (S&P 500 average: less than 2%), many stock funds buy qualified foreign stocks paying 5% to 7%. *Alpine Dynamic Dividend Fund*, for instance, had a yield of 12.6% through October 31, and a total return of 14%. The preferential tax treatment, which will expire in 2010 unless renewed by Congress, applies only to dividends paid by many United States and foreign companies, not to cash distributions earned through other investments of the mutual fund, such as earned interest, even if the fund holds mostly qualified dividend-paying stocks. The mutual fund will designate which earnings are qualified dividends.

> Qualified Dividend Holding Periods: In general, to qualify for the lower tax rates, the taxpayer must hold the dividend-paying stock for at least 61 days during the 121-day period beginning 60 days before the ex-dividend date – the first date that the buyer will not be entitled to receive that dividend. This same condition applies to qualified dividends paid out by mutual funds – the shareholder must have owned the mutual fund shares for a 61-day period that included a payment of dividends.
>
> A similar holding period exists for preferred stock dividends attributable to a period exceeding 366 days. This holding period is at least 91 days during a 181-day period beginning 90 days before the ex-dividend date.
>
> Mutual funds, other regulated investment companies, and real estate investment trusts that pass through dividend income to their shareholders must meet the holding period test for the dividend-paying stocks that they hold in order for corresponding amounts that they pay out to be reported as qualified

dividends on *Form 1099-DIV*. Investors must then meet the test relative to the shares that they hold directly, from which they received the qualified dividends that were reported to them.

The chart given in Exhibit 23.6 classifies funds into three basic categories by investment objective. They also illustrate the correlation between a fund's objective and the risks it may face.

Exhibit 23.6 Classification of funds

Type of Fund	Investment Objective	Risks	Holdings
Income funds			
Corporate Bond	Steady income	Interest rate changes and inflation	Highly rated corporate bonds
High Yield Bond	Highest current income	High risk bonds in danger of default	low rated and unrated
International and Global Bond	High income	Yield dependent on interest and Currency values	Bonds in overseas markets
Short/intermediate term debt	Income	Small risk of loss less influenced by Changes in Interest rates	different types of bonds with 1–10 year maturities
Federal Bond	Steady income	interest rate Changes and Inflation	highly rated government
Growth and income funds			
Balanced	Income and growth	limited risk to Principal Moderate long term growth	stocks & preferreds 60% Bonds 40%
Equity income	do	do	Blue chips utilities
Growth and income	Growth plus some Current income	do	High dividend stocks with growth
Income	primarily income	do	Primarily bonds some dividend Paying stocks
Growth funds			
Emerging markets	Growth	More volatile than growth funds	stocks of companies in developing companies
Equity funds	Imitate the market	average gains or losses for the market the index tracks	Stocks in the index the fund tracks
Global equity	Global growth	Gains and losses depend on stock prices and foreign exchange fluctuations	Stocks in various markets
Growth	Above-average growth	Can be volatile	Stocks in mid-size or large companies whose earnings are expected to rise quickly
International equity	International growth	Potentially volatile	International companies

23.7 Exchange Traded Funds

Exchange traded funds, sometimes called exchange listed portfolios, exchange index securities, exchange shares, or listed index securities, are like closed-end mutual funds in that they are based on a portfolio of securities representing a category or an index and are traded like stocks on organized stock exchanges.

Until recently, the best way to put together a portfolio of stock and bond index funds was to buy index mutual funds. Mutual funds issue shares that are priced after the close of each trading day; the share price is determined by the closing prices of the stocks held by the fund. Investors can buy or sell these shares each day after the shares have priced, and in many cases do not have to pay transaction fees for buying and selling the shares if they hold an account with the mutual fund company. Vanguard pioneered stock index funds, and offers some of the lowest-fee index mutual funds. Vanguard's S&P 500 Index fund, for example, is the largest US index fund.

In the recent years a new product has hit the market that has distinct advantages over index mutual funds. They are exchange traded funds, or ETFs.

Exchange traded funds are similar to index mutual funds. The key difference is that ETFs, instead of pricing once a day after the market closes, are traded throughout the day as if they were regular stocks. If you want to buy shares in an ETF, you buy them as you would buy a stock – namely, from someone else who sells them to you on a stock exchange (thus the name "exchange traded funds"). Investors can calculate the value of ETFs during the day because the composition of the underlying portfolio – normally a published index – does not change. For example, if the ETF tracks the S&P 500 index, investors can calculate at any given moment the value of all the stocks in the S&P 500 index and thus the underlying value of the S&P 500 index ETF. This underlying value is known as the net asset value, or NAV.

Like stocks and shares of closed-end mutual funds, but unlike open-end mutual funds, exchange-traded funds can be bought anytime during market hours, can be ordered conditionally by setting limit orders, prices are based on market supply and demand for the shares rather than the underlying NAV, can be shorted even on a downtick, can be bought on margin, and options – calls and puts – can be based on them. Expenses are very low, from .09% to .65%, because the securities that comprise the fund are not traded very often, and thus, do not generate capital gains tax liabilities for investors that results from such trades in a regular mutual fund or even a closed-end fund.

Generally, an index ETF will do better than an index mutual fund based on the same index because of slightly lower expenses, but only if very few investments are made, because buying an ETF must be done through a broker who charges a commission. For an investor that makes frequent contributions, an index mutual fund would be much cheaper, and the fund would allow automatic reinvestment of income. However, there are some brokers who charge minimum fees for buying ETFs by consolidating such purchases into one large block trade. So it helps to shop around when you do decide to invest in an index fund.

The issuer of an ETF is the Trust and is commonly called the "fund." The fund's investment objective is defined in the prospectus which will be closely tracked with the performance of a specified index or defined broad asset class. To achieve this objective, the fund will act according to the instructions provided by the investment adviser and/or the sponsor. The investment adviser or the sponsor will direct the fund to add and/or remove securities from the portfolio based on changes in the specified index.

Exchange-traded funds, or ETFs, are investment companies that are legally classified as open-end companies or Unit Investment Trusts, but that differ from traditional open-end companies and UITs in the following respects:

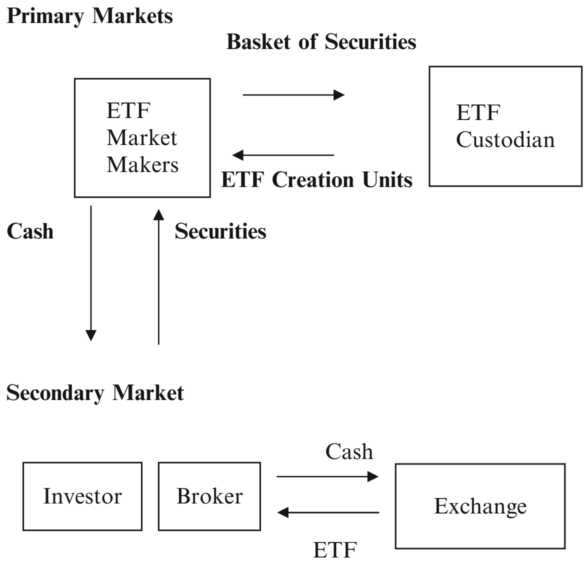
- ETFs do not sell individual shares directly to investors and only issue their shares in large blocks (blocks of 50,000 shares, for example) that are known as "Creation Units."
- Investors generally do not purchase Creation Units with cash. Instead, they buy Creation Units with a basket of securities that generally mirrors the ETF's portfolio. Those who purchase Creation Units are frequently institutions.
- After purchasing a Creation Unit, an investor often splits it up and sells the individual shares on a secondary market. This permits other investors to purchase individual shares (instead of Creation Units).
- Investors who want to sell their ETF shares have two options: (1) they can sell individual shares to other investors on the secondary market, or (2) they can sell the Creation Units back to the ETF. In addition, ETFs generally redeem Creation Units by giving investors the securities that comprise the portfolio instead of cash. So, for example, an ETF invested in the stocks contained in the Dow Jones Industrial Average (DJIA) would give a redeeming shareholder the actual securities that constitute the DJIA instead of cash. Because of the limited redeemability of ETF shares, ETFs are not considered to be – and may not call themselves – mutual funds.

An ETF, like any other type of investment company, will have a prospectus. All investors that purchase Creation Units receive a prospectus. Some ETFs also deliver a prospectus to secondary market purchasers. ETFs that do not deliver a prospectus are required to give investors a document known as a Product Description, which summarizes key information about the ETF and explains how to obtain a prospectus. All ETFs will deliver a prospectus upon request.

The pictorial representation of mechanics of an ETF is shown in Exhibit 23.7.

An important feature of ETFs is that financial institutions can exchange ETFs for the underlying assets they represent with the issuing institution for a small fee. This feature prevents ETFs from trading at systematic discounts or premiums to the value of the underlying assets of the fund. If, for example, an ETF trades at a premium to the value of its underlying assets, a smart institution will sell the ETF short and buy the basket of underlying stocks which it will then exchange for the ETF at actual value, thereby making a profit. The possibility and occurrence of this arbitrage prevents a gap opening between the traded price of the ETF and its net asset value.

Exhibit 23.7 Mechanics of an ETF



ETFs have a tax advantage over mutual funds that – while relatively small – is significant when compounded over time. Mutual index funds, despite their low stock turnover, still distribute some capital gains to their investors most years. Investors pay taxes on these capital gains. S&P 500 index mutual funds distributed 2.03% of their net asset value as capital gains each year, on average, between 1993 and 2001. In contrast, the S&P 500 index ETF made only one capital gain distribution during that period, of 0.12% in 1996, and most S&P 500 ETFs are expected to make no capital gains distributions in future.

ETFs differ from closed-end funds in that ETFs have an arbitrage mechanism that allows certain market makers or institutional investors, who have signed Participating Agreements with the fund sponsor and who are referred to as Authorized Participants (also called creation unit holders), to exchange the basket of securities for creation units consisting of 50,000 ETF shares or a multiple thereof. The exchange involves only securities – no cash – which reduces capital gains taxes for shareholders. Only Authorized Participants can create and redeem ETF shares with the fund sponsor, and they also sell the ETF shares they create on the exchanges to retail investors.

When the ETF share price is significantly higher than the NAV, then Authorized Participants can buy the basket of securities on the open market, exchange the securities for ETF shares, then sell the shares on the market for a profit, which is how ETF shares are created. When the NAV is significantly higher, then the Authorized Participants trade their ETF shares for the basket of securities, then sell the securities on the exchanges for a profit, which is how ETF shares are destroyed. It is this process that keeps the ETF share price and NAV approximately equal, because it takes a certain amount of time and expense to profit from this difference through arbitrage, and the market supply and demand for both ETFs and their underlying securities, with the concomitant affect on prices, change constantly and quickly.

The first ETF, created by the American Stock Exchange in 1993, was the Standard & Poor's Depositary Receipts Trust, usually called a SPDR, or spider, and is based on the S&P 500 index. Two other major ETFs are the QQQQ based on the NASDAQ 100, and the DIA based on the Dow Jones Industrial Average.

A list of available ETFs is presented in Exhibit 23.8.

International Exchange Traded Funds:

European ETFs

iShares MSCI Austria Index

iShares MSCI Spain Index

iShares MSCI Sweden Index

Foreign Large Blend Exchange Traded Funds

iShares MSCI Australia Index

iShares MSCI EAFE Index Fund

iShares MSCI South Africa Index

Japan Stocks ETF

iShares S&P/TOPIX 150 Index

iShares MSCI Japan Index

Exhibit 23.8 List of available exchange traded funds

ETF type	Full name	Tracks
US Exchange Traded Funds		
DIAMONDS	Diamonds trust series 1	Dow Jones Industrial Average
FITRs	Fixed income exchange traded securities	Various Treasuries (1, 2, 5, 10 year)
HOLDRs	Holding Company Depository Receipts (marketed by Merrill Lynch)	Narrow Industry groups
iShares	iShares	Group of ETFs marketed by Barclays Global Investors
QUBEs	Nasdaq 100 tracking stock (QQQ)	Nasdaq 100 index
Spiders	Standard & poor's depository receipts	Track a variety of S&P indexes
Street Tracks	Street Tracks- State Street Global Advisor ETFs Indexes	Various indexes, including Dow Jones style indexes and Wilshire
VIPERs	Vanguard Index Participation receipts	Several Vanguard Index Funds

23.7.1 Legal Structure of Exchange Traded Funds

There are three main legal structures for index ETFs.

Exchange-traded open-end index mutual fund – This type of fund is registered under the SEC Investment Company Act of 1940 in the United States. Dividends are reinvested in the fund on the day of the receipt and are paid out quarterly in cash. Funds are allowed to use derivatives and can generate income from loaning securities. Although there is no minimum amount an investor must purchase or sell, institutional investors can create or redeem shares in-kind in 50,000-share lots. Examples of this structure include the Select Sector SPDRs and iShares

Exchange-traded unit investment trust – This type of fund is registered under the SEC Investment Company Act of 1940 ("the 40 Act"), and must fully replicate their benchmark indexes. However, diversification rules in the 40 Act sometimes force these funds to deviate from the exact index holdings. The 40 Act stipulates that no fund can invest more than 25% of its assets in any single issuer. It also requires that in diversified funds, securities that have an asset weighting of 5% or more cannot compose more than 25% of the total fund. For non-diversified funds, the aggregate limit is 50% of the total fund assets. As some indexes contain company stocks at weights higher than this threshold, several funds statistically optimize their holdings to reflect the index weightings while still adhering to the diversification rule.

Dividends are not reinvested in funds with this legal structure, and are paid out quarterly in cash. Although there is no minimum amount an investor must purchase or sell, institutional investors can create or redeem shares in-kind in 50,000-share blocks. Examples of this structure include the QQQs (Qubes), DIAMONDS, S&P 500 SPDR, and S&P 400 SPDR.

Exchange-traded grantor trust – This type of fund is not registered under the SEC Investment Company Act of 1940, although this structure is the most similar to actually owning the underlying shares of the fund. The fund composition does not change, except to reflect corporate actions. These funds can be redeemed for the underlying securities, and investors have voting rights to the underlying securities. Dividends are distributed directly to the shareholders, not reinvested. Fund shares can be purchased/created and sold/redeemed in 100-share lots. Examples of this structure include the HOLDR funds.

23.7.2 Advantages of ETFs over Index Mutual Funds

A typical goal of an investor is to build and manage a diversified portfolio of stocks and bonds with the lowest possible fees and the greatest possible tax efficiency. ETFs offer several advantages over index mutual funds:

Lower cost: ETFs can have lower expense ratios than the lowest-cost index mutual funds. The Barclays i-shares S&P 500 ETF, for example, charges 0.09% a year in fees, compared to about double that for the Vanguard 500 Index Fund. A diversified portfolio of index funds with a common asset allocation costs about 18% less in annual expenses using ETFs than using Vanguard index funds. A key advantage of ETFs is that since an investor buy them like a stock in a brokerage account, one can pick the cheapest ETFs from all those available. With index mutual funds, in contrast, the investor tends to be locked into a singe family of products. Vanguard, for example, does not offer its index funds via the "fund supermarkets" such as Schwab OneSource; if one wants to avoid transaction fees, one has to open a Vanguard account. But keeping the portfolio with a single fund provider locks the investor into that provider's funds and prevents from shopping around for the cheapest funds.

Given below is the expense ratio for some ETFs:

Fund name	Expense ratio (%)
iShares S&P 500 index	0.09
iShares Russell 2000 Index	0.20
iShares MSCI EAFE Index	0.35
iShares MSCI Emerging Markets Index	0.75
streetTRACKS Wilshire REIT Index Fund	0.25

Greater tax efficiency: ETFs are more tax efficient than index mutual funds. Index mutual funds themselves are highly tax efficient compared to actively managed mutual funds. But they still make capital gains distributions, which means that investors who hold them in taxable accounts (as opposed to retirement accounts) will get hit with tax bills. In contrast, index ETFs generally make minimal or no capital gains distributions. The broader and more liquid the index, the smaller is the capital gains.

Better tax management: Better and easier tax management is possible with ETFs than index mutual funds. This is a key advantage that can result in significant financial differences, particularly for large accounts. If an investor buys ETFs in a brokerage account that tracks tax lots and allows the investor to identify tax lots for sale, the investor can sell ETFs with the highest cost-basis, thereby minimizing taxable gains. With index mutual funds, in contrast, holdings are often reported – and can be sold – using average purchase price only, reducing the ability to realize tax losses (and give away appreciated stock).

Easier asset allocation: Investors can manage asset allocation more easily with ETFs. An investor can buy a basket of ETFs – stock, bond, and REIT indexes – in a single online brokerage account, see all assets in one place, and track asset allocation. The best online brokers offer portfolio analysis tools that chart portfolio allocation. The only way to do this with index mutual funds is if to lock into a single fund family, and do not buy funds from any other providers. In theory, one could manage index mutual funds from different providers using the "Supermarkets" offered by companies like Schwab. But the problem is that Schwab charges the fund companies about 0.35% of assets per year to appear in the supermarket, and that cost is passed on to the investor in higher fund fees. So index mutual funds from Vanguard, for example, do not appear in the Schwab supermarket. That means that if an investor wants to use index mutual funds to allocate funds among different asset classes, the investor likely needs multiple accounts, will not be able to track asset allocation in one place, and rebalancing assets (say from a stock to a bond fund) may involve moving funds from an account at one company to an account at another.

Easier portfolio rebalancing: Investors can rebalance their portfolio more easily with ETFs, as their holdings are easier to track and can use limit orders to buy and sell funds at preset prices. Importantly, the ability to manage taxes better with ETFs means that rebalancing becomes an option in taxable accounts. With index mutual funds held in a taxable account, investors often forced to "buy and hold" without rebalancing because of the tax implications of rebalancing.

Greater transparency: ETFs are transparent and cannot be manipulated. ETFs and closed-end funds are baskets of stocks traded openly on exchanges, where the bid-offer spread is publicly available and reflects current market sentiment. In contrast, mutual funds are purchased at set prices after the stock market closes, creating the risk of legal or illegal arbitrage. This issue is particularly acute for International funds. But the transparency and trading advantages apply equally to both exchange traded funds and closed-end fund versus regular, open-end mutual funds.

23.7.3 Disadvantage of ETFs

There is one disadvantage of ETFs: investors have to pay to purchase and sell them, just as they do with individual stocks. Mutual funds, in contrast, are purchased and sold after the market closes with no fees.

The cost to purchase or sell ETFs is (1) the cost of a stock trade (or multiple trades if an investor is buying multiple ETFs) and (2) the difference between the buying price and selling price (the "spread") at any given moment.

- The cost of stock trades – namely of trading commissions – is entirely in the investor's control: one just has to select a brokerage firm that offers low-cost trades. Buying ETFs at $ 7–20 a trade in an online brokerage account generally makes sense. Buying ETFs at $ 200 a trade generally does not, because the transaction costs can easily outweigh the lower annual fees and convenience. So the ideal product is to combine ETFs with low-cost online trading.
- The spreads on ETFs depend on their liquidity and trading volumes. A Smith Barney study based on January 2002 trades found that spreads on domestic ETFs averaged 0.33% (0.087% when weighted by market cap) and on foreign ETFs 0.87% (0.59% when weighted by market cap).

Given that the spreads on purchasing ETFs exceed the 0.05% cost advantage of an ETF portfolio over an equivalent Vanguard fund portfolio, why would you want to use ETFs? There are five reasons:

- If an investor is investing for the long term, the cost of the spread is eventually outweighed by the cheaper annual fees of the ETFs.
- The compounded return of index mutual funds will be lower than equivalent ETFs in a taxable account because of capital gains distributions. The after-tax return for investors who held the Vanguard 500 fund in the year ending September 30, 2003 (without selling the fund shares at the end of the period), for example,

was 0.72% lower than the pre-tax return. Including state and local taxes, the difference would have been even larger. In contrast, the S&P 500 ETFs made no capital gains distributions in the last few years.
- The benefits of tax-loss selling could easily outweigh the trading commissions and spreads, even in a modestly sized account. Effective tax-loss selling can give an investor a $ 3,000 annual deduction without affecting the composition of the portfolio.
- Ease of tax-loss selling enables you to rebalance the portfolio. Portfolio rebalancing should lower risk and boost long-run returns.
- As ETFs become more popular and competition increases, annual expenses should fall further and spreads contract.

23.8 Concluding Comments

In this chapter, we outlined the types of mutual funds, how they are organized, and what investors must seek in mutual funds. We also contrasted exchange traded funds with mutual funds. The subsequent chapters deal with why some mutual funds choose to track a stock market index such as the S&P 500 whereas others resort to active portfolio management; different classes of funds like exchange traded funds and hedge funds and the analytic process of measurement of mutual fund performance.

23.9 End of the Chapter Questions

1. Compare and contrast open-ended and closed-ended funds.
2. What are the salient features of a mutual fund?
3. Describe the different types of mutual funds.
4. What are exchange traded funds and how are they different from mutual funds?
5. What are the advantages and disadvantages of exchange traded funds?

Chapter 24
Understanding Active Portfolio Management

Laurence Siegel and Barton Waring

24.1 Chapter Introduction and Objectives

Despite the overwhelming evidence on market efficiency and the performance of index funds, investors continue to choose "active" managers who deliberately choose a specific investment philosophy because that is where the action is. It is rare that a fund manager generates abnormal returns for long periods. In this chapter, we provide an overview of active management.

The chapter has the following objectives:

- Define active management
- Outline current practices in active management
- Describe what to expect out of active management

This chapter appeared under the title "The Dimensions of Active Management" in the *Journal of Portfolio Management*, Spring 2003, Vol. 29, Issue 3, p. 35–51.

24.2 The Dimensions of Active Management

Every reader of this chapter either employs active managers or is one. But what exactly are active managers? What is their role in the investor's portfolio? What *should* their role in the portfolio be? What are the real "dimensions" in which active managers vary? Are current practices for building portfolios of managers the best that can be designed, or is there a better way?

Most investors know *something* about the answers to the questions we posed, as common sense goes a long way here. Active managers select securities. They

L. Siegel (✉)
Director of Investment Policy Research at the Ford Foundation, New York

B. Waring
Client Advisory Group

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_24,

invest the portfolio, and it is hoped that they will add "alpha," an incremental return over their benchmark. Investors, for their part, work hard to hire the best managers they can identify. Our ambition here is to support that effort. To that end, we hope to convey two fundamental insights. The first is that one hires active managers to generate what we'll call "pure" active return, or "pure" alpha, knowing that in their efforts to do so they will generate pure active risk. (We use the unconventional modifier "pure" for reasons discussed below.) We also note that building a portfolio of managers is like building a portfolio of anything: It's an optimization problem. And if pure active return and risk are the key dimensions describing active managers, then building a portfolio of managers involves optimizing the trade-off between these two dimensions.[1]

Second, pure active return, subject to a penalty for pure active risk, is what managers should be hired to deliver. And it is what investors should pay active fees for. This is in contrast to current practice that typically draws only a fuzzy distinction between a manager's pure alpha and the market exposures (including style and other systematic risk factor exposures) delivered by that manager. By making this distinction clear, and by quantifying it, one can greatly improve the payoff to the decision to hire active managers. Holding active managers, then, is like any other proposition in finance, the balancing of the hope for gain against the concern about risk. Existing practice does not do a good enough job of managing that tension, and doesn't even explicitly focus on it, but there are new technologies and ways of thinking that do.

24.2.1 What Is Active Management?

You already know that active managers try to beat an asset-class or style benchmark, using securities held in other than benchmark weights. Can this inherently be successful on average? What can such managers do for your portfolio? How should you choose them? How should you weight them in your portfolio? Does more active risk mean more active return? If so, under what circumstances? Active managers are *forecasters*. They use the information available to them, and whatever their native talents are, to make stock-by-stock (or factor-by-factor, or market-by-market) forecasts of pure active return based on information that they believe is not yet impounded in the price, and then they translate these forecasts into portfolios.[2]

---

[1] While there hasn't been much academic research focused on managing active decisions, there is an excellent (if abbreviated) literature on this topic, the most authoritative, general, and up-to-date example being Grinold and Kahn (2000a). The technology described therein can be recast in a form that applies not just to the security selection problem, where their work was focused but also to the manager selection and structuring problem, as previously demonstrated by one of the authors of this chapter. (*See* Waring et al., 2000.) These works provide a substantial bibliography of prior research in this area.

[2] We'll often refer to securities as "stocks," although our comments apply to securities in any asset class or across any group of asset classes. Also, while we'll frame this discussion in the familiar turf of security selection, it applies equally to the alpha-generating efforts of tactical asset allocation, market timing, sector rotation, and other methods of actively managing across groups of securities.

Well, not exactly. The traditional manager typically doesn't make explicit forecasts of stock-specific returns, nor does he/she optimize those forecasts to construct their portfolios. (These practices *are* followed by the best of the risk-controlled active managers.) Instead, traditional managers may establish "price targets" or express forecasts in some other forecasting space that does not translate directly to expected alphas. At the end of the day, they do hold a portfolio of securities, often more or less equal-weighted, that they hope will beat their benchmark. This portfolio is informed more by traditional research, intuition, and experience than by optimization and risk control considerations. However, whether the manager knows it or not, stock-specific alpha forecasts are always there, implied by the bets in the portfolio. They can be backed out of the portfolio holdings, using "reverse optimization."[3]

If you can't forecast better than the average market participant, you shouldn't be an active manager. And if you can make superior forecasts, but don't agree with the forecasts implied by your holdings, then you should have different holdings, consistent with forecasts with which you do agree. Likewise, the *investor* makes alpha forecasts for the *managers* it holds. These forecasts are rarely explicit in current practice, but they are also always implicitly there. They can also be backed out through reverse optimization and they can be embarrassingly large.[4] Investors should only hire active managers if they have skillfully formed positive alpha forecasts for the managers. And if they have these forecasts they should use them. We will get to this in more detail later. Superior forecasting, then, is what generates the positive expected alpha that we hope to earn from hiring active managers. Forecasting is important at two levels, by the managers looking at stocks and by an investor looking at managers.

24.2.1.1 Market Risk and Active Risk, Rewarded and Unrewarded Risk

To begin to identify the dimensions of active management, we must first break up total risk into its "gross" component parts. Following William F. Sharpe's most famous work, the total risk of any investment can be broken into: (1) *market risk*, also called policy, systematic, undiversifiable, or beta risk and (2) *pure active risk*, also called specific, unsystematic, idiosyncratic, diversifiable, or alpha risk (risk goes by many names).[5] Policy risk is usually managed by investors through their adoption of a strategic asset allocation (SAA) policy, with its attendant asset-class benchmarks, all of which are fully diversified and which therefore carry only market risk by definition. Active risk comes into the investor portfolio through the use of active

[3] In addition to the weights of the securities held, for reverse optimization, one needs a reference portfolio (the benchmark), estimates of the pure active risk (standard deviation) of each stock, the correlation of each stock with every other, and the expected alpha for one of the stocks (to get the scale right). For a general discussion, see Sharpe (1964).

[4] A very simple case: If three active managers hold half the portfolio (the other half in index and enhanced index), an 8% expected alpha may be implied for them!

[5] See Sharpe (1964).

managers who, while holding some components of the policy benchmarks, try to beat them.

Finance academics have focused much of their research in the last few decades on market risk, observing that if markets are efficient then "you can't beat the market." In practice, however, investors don't seem to completely believe them. Investors still routinely hire active managers, whose returns can differ widely from benchmark returns. In fact, the all-passive institutional portfolio is a rarity, the academic insight being honored solely in the breach. So active risk is in fact taken, in the search for pure active return, and this trade-off needs to be managed as well as the trade-off between market return and risk that is at the heart of asset allocation policy.

Capital markets must function so that the expected return on the overall equity market must be higher than that on fixed-income investments.[6] As a result, fully diversified market risk (such as one takes by buying an index fund) must be rewarded. Pure active risk, in contrast, cannot be rewarded *on average* since active managers are betting against each other in a zero-sum game.[7] Particular active managers, of course, will beat the market by a large margin – but they are doing so at the expense of the others, either through luck or through special skill. But active managers (and other market participants) in aggregate *are* the market, so they must again in the aggregate earn the return on the market – minus fees, transaction costs, and other expenses, which can be substantial.[8]

24.2.1.2 Where's the Beef?

Does this mean that investors should only index, shunning active managers entirely? Not efficiency story is incomplete: Under a couple of fairly easily satisfied conditions, you *can* beat the market. Note carefully: As long as a market is not completely efficient (and we believe that none are) and as long as there are native differences in human intelligence and skill levels (of course there are), *some managers will outperform through real skill, not just by virtue of random variation.* Under

[6] While the difference in returns between equity and fixed-income markets (the "equity risk premium") may vary in size over time, logic pretty much dictates that its expected value must always be positive for markets to clear. See Grinold and Kroner (2002) and Leibowitz et al. (2001).

[7] The "Evans-Archer" diagram (*see* Evans and Archer 1968) is the classic tool used to introduce this point, showing risk declining asymptotically down to some irreducible amount as the portfolio becomes more and more diversified. Although Evans and Archer were only contrasting policy and active risk, without saying what risks were rewarded, one can deduce that diversifiable risk need not be rewarded since investors can avoid it, almost for free, by indexing, but the undiversifiable risk does need to be rewarded. Sharpe (1964) shows that, under the stringent assumptions of the CAPM, policy risk is associated with an expected reward while active risk is not. Many subsequent observers have criticized the CAPM as relying on unrealistic assumptions or as being empirically unsupported. However, Ross (1976) demonstrated in the context of developing his Arbitrage Pricing Theory that, even if the CAPM conditions do not hold, policy risk is still rewarded while active risk is not. Thus, while acknowledging the limitations of the CAPM, we can proceed with confidence in dividing investment risk into rewarded and unrewarded components.

[8] This version of the argument is developed most eloquently in Sharpe (1964).

these conditions, the notion that there can be an "expected alpha" or pure active return makes perfect sense. It is important to note that while market inefficiency is a *necessary* condition for "good" active managers to exist, it is not a *sufficient* condition—skill is also required. But no manager will ever have so much skill as to be able to manage the portfolio without adding some active risk. We measure skill with an "information coefficient" (IC), a correlation coefficient of forecasts with realizations. Forecasting skill will seldom carry a very high IC, so there will always be risk left over and a chance of underperformance even in the hands of the "quite good" manager. This risk represents variability in active returns not explained by skill but rather by luck – "the luck component."

But no manager will ever have so much skill as to be able to manage the portfolio without adding some active risk. We measure skill with an "IC," a correlation coefficient of forecasts with realizations. Forecasting skill will seldom carry a very high IC, so there will always be risk left over, and a chance of underperformance even in the hands of the "quite good" manager. This risk represents variability in active returns not explained by skill but rather by luck. The luck component of risk, period-by-period, is nearly as large for the skillful as for the unskillful manager. Over long time spans, of course, positive alpha is much more likely to accumulate for the skillful.[9] So the bad news is that active management overall is in fact a zero-sum game. But the good news is that for the skillful investor, there is an opportunity to add value to the portfolio over and above market returns. This really is good news, especially if you contrast it with the returns to be expected from your benchmark and SAA decisions.

24.2.1.3 Definitions

Alpha, "pure alpha," "pure active return," "selection return," "specific return": The portion of the return that is not explained by the market risk exposures of the portfolio, the real return generated over and above a manager's custom benchmark or normal portfolio.

"Pure active risk," "omega": The standard deviation or other measure of volatility of the alpha.

Active return, "simple active return": The sum of the alpha plus any additional return resulting from the manager's holding less (or more) than a "beta equals one" exposure to the benchmark.

Active risk, "simple active risk": The standard deviation or other measure of volatility of the active return.

Utility: A form of risk-adjusted return. Expected returns are decreased by a penalty proportional to the risk (variance) of the return stream.

[9] The magnitude of the component of variance that is explained by luck rather than skill is surprisingly large. Since the IC is just a correlation coefficient, for a process with correlated signals we can convert it to an R^2 by just squaring it (Grinold and Kahn, 2000a, p. 292). A manager with a very respectable IC of 0.10 would have an R^2 of 0.01, meaning that just 1% of actisve variance was explainable by the manager's skill, the remaining 99% of active variance being just random luck. Astounding. Small wonder that it is so difficult to separate skill from luck over short time periods.

Traditional active management: The typical form of active management most commonly practiced, characterized often by heavy use of security analysis, often by equal-weighted portfolios. Active risk levels run from around 4% up to as high as 25%, with the norm being around 5–6%.

Risk-controlled active managers: Heavy use of technology to gather data and evaluate insights about individual securities, and heavy use of advanced processes to form these insights into optimal portfolios having minimal uncompensated risks. Tend to have low active risk levels, 1–3% or so.

You can't influence or control the return of your SAA policy: The market is going to do what the market is going to do.

Other than making a risk level decision – to be more or less aggressive in your SAA policy (either in an asset only decision or preferably with respect to your liability) – you're just a passenger. But if you have skill at security selection (or market timing or sector rotation, any active process), you have some *control* over returns, and this will add value, pure alpha, over and above the return of the SAA policy. The search for such alpha is, arguably, the investor's highest calling. Remember, we're not saying it is easy; it's not, but it can be done.

24.2.2 Defining "Pure" Active Return and Risk: What Should Managers Be Hired to Deliver?

We agree on the separation of market or policy risk and pure active risk, in principle. Let's go one step further and apply it in practice, separating these "gross" components of market risk (and return) and pure active risk (and return) in a real world context. The returns that usually pass for alphas – the simple differences between the benchmark return and the manager's return – are properly known just as "active returns" (without the "pure"). But these "simple" active returns might have more or less exposure to market risk than the amount implicit in the investor's benchmark.

Market risk can be measured by a CAPM single factor beta, or, more usefully, in a multifactor manner. The most intuitive of these multifactor approaches measures market risk in terms of *style factors* – the familiar large-capitalization, small capitalization, value, and growth categories.[10]

[10] We aren't really sure who was first to classify investments or managers based on regression factors, but certainly Barr Rosenberg and his successors at BARRA have been the most complete at making this practice into a science. See *www.barra.com/research/barrapub/risk_models.asp* for a good introductory level description. Sharpe (1988, 1992) saw that style and size factors could be productively and intuitively used in such regressions (called returns-based style analysis), and did much work in the area involving special types of regressions designed to make the output more intuitive to lay audiences. Sharpe's approach is certainly the most commonly used in practice. For determining which styles or common risk factors are most relevant for use in returns-based style analysis, one authoritative source is Fama and French (1993), drawing on the much earlier observation by Banz (1981) and Reinganum (1981) that small-cap stocks had historically outperformed larger-cap stocks, and the observation by Basu (1977, 1983), among others, that "value" stocks

Other, often more complex, factor models have been identified that more completely explain market risks, but some of these are hard to describe in plain English so we'll stick with style factors in this discussion. Style factors also have the benefit of convenient investability through low-cost style index funds. The manager's returns, then, can be explained in terms of the exposures, or betas, to an intuitive series of style factors that express the manager's return from market risks, plus a pure alpha, or the return generated over and above market returns. Simple active return and pure active return are only the same if the manager's factor exposures are weighted the same as they are in the benchmark. Since the benchmarks flow from the SAA decision, managers can and should be chosen with factor weights such that, at least in sum across the managers, they are consistent with the benchmark's factor weights.

So once a set of market factor weights – a custom benchmark such as "large-cap growth" or "80% large-cap value and 20% large-cap growth" – is set for a given manager, the proper objective of the manager is simply to beat that customized benchmark.

That's why you hire active managers. You hire them to give you the levels of market risk exposure that you expect from them and which you assigned to them through their customized benchmark, and to beat that benchmark. If a manager does anything else, with or without the knowledge of the investor, it is stealthily changing an important aspect of the investor's SAA policy. The common term for this is "misfit" risk, but it's really the risk that the particular mix of benchmarks representing one's SAA policy is not being delivered. In other words, the valuable and important return added by a manager isn't the total return that he or she delivers, but only that part of the return that is *beyond* what could be delivered through a set of index funds reflecting the manager's persistent style biases, its market risk exposures. This unique contribution of the manager to the return is what we're calling *pure* active return, or *pure* alpha. We know we're being redundant to say "pure" alpha, but we're trying to call attention to this precise definition, one that doesn't contain a market (or style) risk component, for the reasons stated in the prior section. It is also what Sharpe meant by his term "selection return" in his work on style analysis, and what those familiar with the very detailed factor models of BARRA know as "specific return."

Realized pure alpha is easily separated from market risk factors and is measured by regression analysis.[11] The regression determines the effective style weights of the manager, or mix of style benchmarks that has the "best fit" to the manager's actual

(having low price/book, price/earnings, or other valuation ratios suggesting that the stocks were cheap) had outperformed "growth" stocks (having expensive valuations).

[11] Realized pure alpha may be determined by an actual multivariate regression or by a constrained optimization technique that mimics a regression such as Sharpe's style analysis method. The purpose of the optimization technique is to allow for a no-shorting constraint, that is, to require all factor betas to be between zero and one. We generally prefer ordinary regression, for its greater ability to accurately describe "deep" value and growth managers. Pure active return, of course, is properly thought of *after* fees. One should also incorporate manager transition costs into the pure active return; these must be amortized over the time period for which the manager is likely to be

returns. The pure alpha is then the residual, the manager's actual return in excess of the return on this amount of market risk. On a forward-looking basis, we *assign* to a manager his or her customized benchmark or "normal portfolio," capturing the style and other market risk exposures that will best describe that manager's neutral, or "home," position. It's easy for index funds or risk-controlled active managers.

For others, this customized benchmark might be informed by the historic regression and by any other information that is useful to characterizing the normal style biases of the manager. Even a TAA manager or a style rotator has such a "home" position. The view of market risk that we've been describing, by the way, is continuous and scalar – that is, a manager can have any amount of exposure to a single benchmark or to multiple style (or any other factor) benchmarks. The market exposure or style weight, at its essence, is just a *beta*, after all. And betas are a good way to determine or describe the level of exposure to any market risk.[12]

One additional idea: The investor may or may not be able to collect a portfolio of managers whose normal portfolios, in the aggregate, look like the benchmark. The misfit risk of a single manager goes away if it is cancelled by misfit risk of an opposing character from another manager (a growth manager is offset by a value manager, a large-cap manager with some small-cap exposure is offset by a small-cap manager with some large cap exposure, etc.). But such perfect offsets of style and other factors are not often the case. So when we're optimizing a manager structure, as we do below, we'll be optimizing pure active return against *total* active risk – and on the risk side, we'll control not only the pure active risk added up from each manager but also the *net* misfit risk taken across all managers, calculated properly using scalar values for the managers' exposures to all the market risk factors we are tracking. This net misfit risk is a part of the active risk investors actually face.

The standard deviation of the period-by-period pure alphas may be thought of as the *pure active risk*, representing the tracking error to the manager's customized benchmark.

These two parameters,

- Pure active return, or pure alpha, a
- Pure active risk, q (known as the Greek letter "omega"), can be combined to arrive at a single measure of manager achievement (either historical or expected), the:
- Pure information ratio, IR $= \alpha/\omega$ representing the amount of pure active return delivered (or expected) per unit of pure active risk taken (or expected) by an individual manager, relative to its customized benchmark.[13]

---

held, so that the cost (which is paid only when the manager is hired or fired) is properly converted into annualized return form.

[12] The CAPM uses just a single factor to capture the market. We are simply trying to control risk relative to the asset allocation policy better, by dividing market risk into more granular subcomponents. Either way, regression is a useful model for sorting out the market and idiosyncratic components of risk and return.

[13] In our experience, some investors don't find that the term "information ratio" conveys much intuition about its meaning. So, observing that IR measures the consistency with which the active

Across the portfolio of managers held by the investor, the denominator would be the aggregation of the q terms plus any net misfit risk remaining across the group of managers. We indicate this "simple" active risk as *jA*. One wishes for the misfit component to be zero across all managers, but in practice, it is difficult to make every last bit of misfit risk go away.

Now that we've defined pure active return and risk, we can use these measures (and particularly the ratio of return to risk, the pure information ratio) as well as misfit risk, to compare any manager with any other – across asset classes, styles, and risk levels – creating a level playing field for all managers. Even more importantly, we can use these measures to properly separate investment results that are the investor's responsibility from those that are created by the manager. The returns delivered by the capital markets on the particular mix of styles that constitute the manager's custom benchmark are the responsibility of the investor who selected the manager, if only because the investor is the only party in a position to control the market risk exposures across his or her whole portfolio of managers. Too often, performance evaluation practices confuse the benchmark return and the pure alpha, apportioning credit and blame incorrectly. Even the smartest and most well-intentioned investors are sorely tempted to blame the active manager, rather than themselves, when the manager's asset class delivers a poor policy return (no matter what pure alpha the manager achieved). With the pure active return and risk clearly defined and calculated, these errors need no longer occur. As a common example, think of the value managers that boast of beating the S&P even when they fail to beat the value benchmark. Which one should they really be held against? If managers persistently choose to exercise their expertise in one domain of market risk such as "deep value," isn't that the domain against which their value-added should be measured by clear-eyed investors?

24.2.3 What Are Active Managers for? Maximizing Active Return Minus a Penalty for Active Risk (Maximizing Expected Active Utility)

So why hire active managers? They provide the possibility of adding pure active return, of course, but they also add active risk. The risk added by active management is, in and of itself, undesirable, so a manager has to do more than just have an expected alpha that is positive. He or she must add enough to more than compensate for the added risk. Active managers are there to add *utility*, not just expected return.

---

return is delivered, perhaps "consistency ratio" would be a better term for this concept, and one more likely to be commonly appreciated. IR is a key measure of historic "goodness" for a manager, and on a forward-looking basis is a key input into the manager's role in the portfolio. It is very useful – it incorporates the two key dimensions of active management into one measure.

The methodology for determining the utility of active decisions is parallel to that for SAA decisions. In general, the expected active utility (or usefulness, or desirability) of a portfolio of active managers is equal to its expected alpha, minus a risk penalty for active risk:

$$E(U_\alpha) = E(\alpha_p) - \lambda_\alpha E(\sigma_\mathrm{A}^2)$$

where $E(U_\alpha)$ is the expected utility of active management in the portfolio, $E(\alpha_p)$ is the expected alpha on portfolio p, λ_α is the active risk aversion parameter for the investor (or the rate at which risk is translated into a negative return, or disutility), and $E(\sigma_\mathrm{A}^2)$ is the simple active risk (expected variance) of portfolio p (including both omega risk from each manager and the net misfit risk across the managers).

How do we figure out whether a portfolio that includes active managers provides incremental utility over the benchmark, that is, whether the combination of managers selected adds enough expected alpha to justify the extra risk? How, taking this one step further, does one *maximize* expected utility? Through optimization. Although Harry Markowitz created this tool a half century ago, and although it's the dominant practice for building efficient portfolios of asset classes and, increasingly over the last 15 years, of securities within an asset class,[14] optimization has just begun to be used for building efficient portfolios of *managers* within the investor's portfolio over the last six or seven years. But why? Building a portfolio of managers is like building a portfolio of anything: It's all about balancing risk and return, trying to find the best trade-off. Optimization is the technology that explicitly calculates these trade-offs in search of the highest utility portfolio (of anything) for a given investor. So increasingly, and as a result of thinking about how managers interrelate in the total portfolio's utility function through optimization, investors are beginning to see their task as one of building *portfolios* of managers, in place of the conventional approach of looking at each manager in isolation. To accomplish that task, investors hiring managers are increasingly using optimization as a portfolio-building tool. Specifically, one must optimize on the managers' pure active return and risk – the real dimensions of active management – while dealing with the other (policy and misfit) return and risk components in a sensible way such as we describe.

24.2.4 Building Portfolios of Managers: The Current Common Sense

Before going more deeply into our prescriptions for better approaches based on optimization, let's hold up to the mirror a couple of the chief features of current practice for building portfolios of managers. These features represent a good portion

[14] At least among the more sophisticated, scientifically oriented managers. See Markowitz (1952, 1991). The research by Grinold and Kahn (2000a), oft-cited throughout this chapter, is a complete and up-to-date text on this topic.

of the "common sense" that guides us in manager structure today. Albert Einstein said, "Common sense is the collection of prejudices acquired by age eighteen."[15] But is this good enough?

24.2.4.1 Performance "Horse Races": Mining the Historical Data

The most widespread current practice for building portfolios of managers is to assume, tacitly if not explicitly, that managers will continue to earn whatever alpha they've been earning in the past. Great effort is put into identifying and sorting candidate managers based on their historic active returns, despite massive evidence that past performance is at the very best a weak predictor of future results, and despite the muddling of these returns with market components.[16]

That's probably because analysis of past performance is something that investors can do with a sense of objectivity and confidence. It's hard to argue with actual historical returns. They provide a feeling that one is dealing with something real and concrete. Except when making forecasts.

While past performance should not be ignored – it is one of many factors that should be considered when evaluating a manager – the investor should remember that performance track records do not, by themselves, distinguish between luck and skill. Two managers, one lucky (but producing random variation around the properly style-adjusted benchmark) and the other truly skillful, can have the same track record. This can even be true over fairly long time horizons. We'd like to give credence only to "statistically significant" performance data, right? Statisticians use the t-statistic to test whether data are statistically significant – more precisely, to test whether one can conclude with reasonable confidence that any given alpha, positive or negative, was achieved through skill rather than luck. There is general agreement (with only minor quibbles) that if a manager's alpha over the period studied is more than two standard deviations away from that of the benchmark (that is, if its t-statistic is greater than two), we can say the manager has a "statistically significant" alpha. This simply means that there is a very high probability (roughly 95% if alphas are normally distributed) that the manager's alpha really is different from zero. It is evidence of skill rather than luck.[17]

---

[15] Quoted in Bell (1952), at www-gap.dcs.st-and.ac.uk/∼history/Quotations/Einstein.html

[16] See, for example, Kahn and Rudd (1995) which contains an extensive review of the literature on the topic up to that time, which happens to include most of the relevant literature even today. Further work on the topic has been done by Carhart (1997) and Wermers (2000) and their results do not differ much from those summarized in Kahn and Rudd (1995). Most of these performance studies cover mutual funds because of easy data availability, but the findings are extremely likely to apply in roughly the same way to institutional funds, which are largely managed by the same managers.

[17] To calculate a manager's alpha t-statistic, divide the realized historic monthly, quarterly, or annualized arithmetic alpha (regression or pure alpha) by the standard deviation of that alpha (expressed at the same frequency), and multiply the result by the square root of the number of periods represented in the data. Note that if the data is expressed in annualized terms, this result is just the

Here is why we digress on statistics: If a manager's historic alpha is not statistically significant in this way (high t-statistic), it makes no sense to even consider whether the manager's historical alpha will repeat going forward. Since a lack of statistical significance says that we don't even understand whether the underlying nonrandom component of the alpha was different from zero or not, the data are meaningless noise and should not be used. That's what "not statistically significant" means. The investor will have to make his or her alpha forecast for that manager based on a more qualitative or fundamental type of analysis, which of course can be done – it is just hard.

On the other hand, if a performance history does display statistical significance, then it is fair to include it among one's other inputs when evaluating a manager, but still one doesn't just extrapolate it into the future without thought. A high t-statistics doesn't by itself prove skill, but a low t-statistics should be interpreted as meaning that the performance record, at least, shows no evidence of skill.

If we cannot usually rely on past performance to select active managers, then how can we select them at all? We don't have a recipe, and we know that there aren't any recipes – if there were one, everyone would be following it and of course then it wouldn't work. Each investor will have to develop his or her own methodology for forecasting manager alphas, but the key ingredient is the tough one – one has to have great insight and ability.

It's no different from how excellent active managers pick stocks: they use a tremendous amount of research into fundamentals, and at the end of the day, they make a judgment call informed by their trained instincts. In "Those pesky expected alphas," below, we touch on other issues related to forecasting alphas for managers.

Unfortunately, significant t-statistics on managers are quite rare – although such rarity is exactly what theory predicts.[18] We almost never see t-statistics used because using them would require the investor to throw out and not use the historic alphas in most all cases. Ignoring historical returns seems at first blush like a peculiar practice, but isn't it right to reject historical data when they contain no useful information?

24.2.4.2 Style Boxes and Style Maps

A practice that has been dominant over the past couple of decades or so, and that is less than ideal, is to divide the equity universe into "style boxes" – where the boxes are large value, large growth, small value, small growth, and perhaps midcap

information ratio times the square root of the number of years of data. Every regression software package, including Microsoft Excel™, provides this t-statistic automatically whenever a regression is conducted. By using a regression alpha, we eliminate any accidental market return effects that might otherwise distort the manager's actual non-market-related returns. It is pure active return, or alpha.

[18] Indeed, BGI enjoys significant t-statistics in the majority of its active strategies, measured since inception. We note this, of course, only to show that successful active management is indeed possible (we would hate to taint our scholarly argument with a commercial!).

and/or core categories – and then to "staff" each style box with managers. This practice seems useful for breaking up the arduous manager-selection task into manageable pieces. The idea is to assign managers to each of these buckets, and that once the buckets are all staffed, the plan is well structured.

Since a cap-weighted combination of all the style boxes gives you back the market portfolio, it might appear that there's nothing really wrong with style boxes per se. Unfortunately, value managers, growth managers, large-cap managers, and small-cap managers don't all come prepackaged cleanly in these boxes: Some are stronger ("deep value") or weaker (growth at a reasonable price) than others, the amount of "valueness" or "growthness" not always coming in units of one. Many large capitalization active managers are equal weighted, and as a result end up having some amount of "small-cap" exposure and less than full "large-cap" exposure (and vice versa for most small-cap managers, who seem to hedge a bit toward large stocks). Anyone who has conducted style analysis on managers knows that it is common for, say, a growth manager to be characterized as 70% in large growth, 15% in large value, 10% in small growth, and 5% in small value.[19] Particularly for traditional active managers, style exposures usually come from a continuous spectrum, not from an "all or nothing" bucket. (The percentage weights, by the way, are just a convenient way to express the betas of the manager relative to the style factors.)

Rather than simply using boxes to represent styles, some investors plot their managers – and their total portfolio of managers – on a style map. Managers who don't fit neatly into a style box can be hired in such an improved framework, as it is usually calculated in a manner that accommodates continuous, scalar values. The investor's total portfolio style map displays the net misfit of the portfolio. One can also use it to simulate changes in managers, or in manager weights, to see the effect on misfit risk and other portfolio characteristics.

Style maps are much better than style boxes since they recognize the continuous nature of styles and the importance of managing *net* misfit risk, across all managers. If an investor isn't going to formally optimize as we suggest in this chapter, style maps and tables of the "effective asset mix" are the next best thing.

But the fundamental problem with using either style boxes or style maps to organize the manager structure effort is that neither one *requires* the investor to deal "face to face" with the managers' expected alphas. Used in the conventional way, style boxes and maps can subtly invite the investor to just "fill them up," without critically examining his or her skill at assessing expected manager alpha or the relative expected alphas of the candidate managers. For investors that aren't strongly disciplined, style boxes and maps invite taking on active risk without a real expectation of pure active return.

As we've already noted, many of the investors who rely heavily on recent past performance and on style boxes as aids in selecting managers are also strongly biased toward traditional active management, with its high degree of active risk. They do so because they equate greater active risk with greater active return. Such

[19] One can use either returns-based or holdings-based style analysis, or both, to calculate these weights. There is no clearly best single method.

investors often express disdain for risk-controlled active strategies, and a preference for concentrated, high-risk active strategies. The refrain, when faced with a low-risk active strategy, is "But I want more juice!"

Such investors make two mistakes. First, having learned that "risk is related to return," they fail to distinguish between policy risk (which is in fact associated with a higher expected return) and active risk, which is only rewarded conditionally on skill. More juice, by itself, isn't going to accomplish anything. Second, such investors don't realize that their *optimal* portfolio of managers, at whatever active risk level with which they are comfortable, will be constructed from good low-risk active managers in preference to higher-risk managers, for two independent reasons. The first of these is that the mathematics of optimization dictates that an investor's manager allocation should be dominated by managers that have a combination of the highest forecast information ratios and the *lowest levels of active risk*. Next, due to the no-short-selling constraint, high-active-risk portfolios tend to have *lower information ratios* than low-active-risk portfolios at the same level of manager skill. Feed this lower information ratio back into the first reason, and you see a loop that requires unimaginably high skill levels to justify giving large allocation to concentrated managers.

We conclude that sophisticated investors don't really want "more juice" – what they really want, or should want, is higher alphas, and less risk. We cover these concepts more thoroughly in the next section 24.2.5.

24.2.4.3 Current Practices: Conclusion

Although in practice they are informed by the best efforts of investors, the conventional dimensions within which active manager decisions are framed – historical alphas, style boxes, and the search for "more juice" – are not clearly focused on the investor's goal of adding value, or utility, to the portfolio. Practices for building portfolios of managers could be better attuned to the real dimensions of active management, maximizing expected alpha while controlling active risk. Can we suggest practices that point in that direction?

24.2.5 Building Portfolios of Managers: Tomorrow's Best Practices

24.2.5.1 From Securities to Managers: Treat Each Manager like a Stock

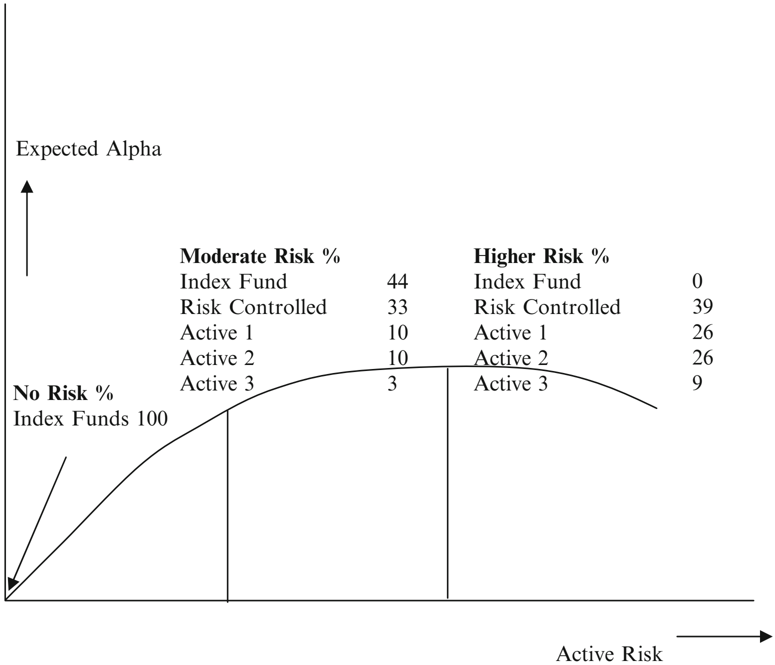
Active return/active risk optimization may not be what investors first think of when they set out to build a portfolio of managers, but it has been growing in use for building active portfolios of *stocks* for well over 15 years. It is becoming common practice in that context, having many advantages over traditional methods of constructing active stock portfolios. What we are suggesting now is simply to treat each manager as one would a stock, giving the investor the same powerful tools for managing its portfolio of managers that the best managers have for managing their portfolios of stocks. Specifically, one must optimize the managers' pure active return and risk – the real dimensions of active management – while dealing with the other (policy and misfit) return and risk components in a sensible way.

We set up the utility function for this optimization earlier. Now, let's implement it using managers as the "securities" or "stocks" across which we will optimize. From this, we can construct an active efficient frontier across managers, an example of which is shown in Exhibit 24.1.

Thus, following Waring et al. (2000), who call their method "manager structure optimization" (MSO) to echo Markowitz's MVO, or mean-variance optimization, we can implement this utility function on a practical basis.[20] We need only to form the investor's estimate of:

1. The expected pure alpha and pure active risk of every manager.
2. The expected correlation of every manager's alpha with that of every other manager.

Exhibit 24.1 Efficient frontier of active managers



[20] Correcting an error in the optimization formula at Eq. (2) in Waring et al. (2000), the first term, representing "misfit return," should have a beta in it, as follows: $(h^T X - \beta h_b^T)r_k$. If the return and risk assumptions are all estimated in such a way that they fall onto a common security market line, this is a zero term. In this case, the whole term can be dropped.

3. The market factor betas that fairly characterize each manager's normal portfolio.
4. The expected return and risk of each market factor used, and the expected correlation of each factor with every other factor.

Whew! This looks more daunting than the usual list of MVO inputs. However, it's easier than it looks. The correlations of the pure alphas are often simply estimated as zeroes. This is for two reasons. First, we have taken the market-related risk factors out by calculating a regression alpha, the pure active return that is uncorrelated with the market factors. While this doesn't necessarily mean that all common factors have been removed from the alphas such that they are necessarily uncorrelated with each other, they will by virtue of the process tend to have low correlations.

Second, we observe in alpha histories that the correlations are in fact low, generally running between -0.2 and $+0.2$. Given the sample error in those observations, one fair solution is to regard all the alpha correlations as zero on a forward-looking basis unless there is a specific reason to expect some pair to be different.[21]

The third and fourth items are the descriptions of the managers' customized benchmarks, expressed in terms of the market risk factors that are relevant to the manager structure question at hand, and the capital market assumptions related to those market risk factors. Analysts are used to providing capital market assumptions for SAA work; the assumptions used for MSO should be consistent with the SAA assumptions (but may need to be more detailed).[22]

The difficult item is the first, and in particular the return component of it, expected alpha. We'll come back to this in a minute. Notice in Exhibit 24.1 that at zero active risk, only an index fund is held, but that as risk tolerance increases – going to the right on the efficient frontier – the proportions held in risk-controlled active and traditional active increase. Another, more detailed, example is in the Appendix.

In our experience, practically everyone sees our point that the key dimensions of active management are expected alpha and active risk, that these need to be balanced, and that building portfolios of managers should be an optimization problem. In theory, they follow along and nod their heads in agreement at each step in the progression of the discussion. But also in our experience, as soon as it sinks in that, they will need to form specific numerical estimates of the expected alpha of their candidate managers, the mood often changes. For some, the efficient-market and zero-sum-game alarm lights go on in their heads. They can't see themselves

[21] At least for US equity managers. For international equity managers and for fixed income managers, correlations between pure alphas are empirically nonzero (because these asset classes have fewer degrees of freedom – in fixed income, there are only a couple of major bets to be made, and for international equity managers, there appears to be more emphasis on regions and industries than on individual security selection). Thus, one might wish to make specific estimates of manager cross-correlations when dealing with these asset classes.

[22] There are few factors if one uses style analysis, but not necessarily so few if one were to use a more detailed factor model such as BARRAs. The good news is that the highly detailed factor models are commercially developed and conveniently come with capital market assumptions for each factor.

estimating alphas so that the optimization problem for managers can be solved in practice, and they mentally start moving back to their comfort zone, filling out style boxes. But these same investors – who quail at the task of forming expected alphas on efficient-market and zero-sum-game grounds – almost always do in fact hire active managers. The resulting portfolios contain *implied* alpha forecasts, which, as we pointed out above, can be calculated through reverse optimization. Thus, investors are forecasting expected alphas whether they resist the notion or not. Worse yet, they don't know what alphas they have implicitly forecast, and if they did know they would quite likely reject many of them as unreasonable. How can one reconcile these conflicting impulses? If you don't think you can forecast alphas, expressing a quantified degree of confidence in a given manager, then maybe you shouldn't hire active managers. You should index instead. If you are going to hire active managers, you might as well make alpha forecasts explicitly, rather than implicitly, since that is more honest and productive than simply selecting some active managers and hoping that the alpha forecasts implied by the holdings weights turn out to be accurate.

Having done that, run an optimizer to select the portfolio.[23] However, if the prospect of specific numerical alpha forecasts for managers is too daunting, then at the very least *think about* manager selection as an optimization problem. Your goal, as in any problem in portfolio construction, is to control risk while maximizing expected return.

Don't worry – you don't have to be a prophet, just a good forecaster. In other words, you don't have to be right about every forecast, just a little bit more right than wrong, across all forecasts, to add value over time (see footnote for suggestions for forecasting alpha).[24]

---

[23] As Michaud (1989, 1998) has pointed out, optimization outputs are no better (and may in fact be worse) than the quality of the inputs, which are statistical estimates and thus subject to natural estimation error. Kritzman (2003) has responded by noting that, for any given set of inputs, optimization is still the tool that gives the best outputs. He also makes many valuable suggestions about forming good forward-looking optimizer inputs.

[24] To get started in forecasting alphas, investors might consider using the forecasting relation: Alpha $=$ IC $\times$ volatility $\times$ score where IC (information coefficient) is a measure of your manager selection skill, the expected correlation between one's forecasts and the subsequent realizations of those forecasts. Volatility is the standard deviation of the return being forecast (omega risk, volatility of the pure alpha), and score is the strength of the manager being evaluated, expressed in standard deviations above or below zero (a score of $+2$ or -2 would be considered very strong, and a score near zero would be weak). This formula is further elucidated, in a security selection context, in Grinold and Kahn (2000a). Additional improvements to recognize that most managers are subject to the long-only constraint, and to include the effect of fees, can be incorporated. The score is the key input variable. A two-standard deviation manager, with a score of 2, is the type of unusually skillful manager one might hope to find, but of course is quite rare. For IC, if you have no skill at manager evaluation, put in a zero (you're only right about managers half the time) and quit. Those truly blessed with selection skill might try a 0.3 (you're right about managers 65% of the time) or if you're rakishly overconfident, a 0.5 (you're right about managers 75% of the time!).

24.2.5.2 Why Low-Active-Risk Managers Are Preferred: Reason Number One

All of these prescriptions embed the idea that active risk is, in and of itself, bad – that of two equally skillful managers (i.e., having the same information ratio), the lower-active-risk manager is to be preferred. But why? Grinold (1990) and Kahn (2000) show that the optimal solution to the utility for active management must, as a matter of mathematical necessity, be consistent with the following relationship:

$$H_{\mathrm{mgr}} \sim E\left(\mathrm{IR}_{\mathrm{mgr}} \times \frac{1}{\omega_{\mathrm{mgr}}}\right)$$

where H_{mgr} is the holdings weight of portfolio or manager (its percentage allocation), $\mathrm{IR}_{\mathrm{mgr}}$ is the expected information ratio of the manager, and $1/\omega_{\mathrm{mgr}}$ is the expected volatility of the manager's pure alpha around a properly established benchmark.

Here's the translation: The size of a manager's allocation is *directly* proportional to the expected information ratio and *inversely* proportional to the level of active risk. If this seems to punish for risk twice (because active risk is also in the denominator of the information ratio), it does. Risk squared, or variance, is the real operator. So another way to state this result is that a manager's allocation will be higher in direct proportion to a higher expected *alpha* and in *inverse* proportion to active *variance*.

Remember the "I want more juice" discussion?

No, you don't want more juice. You want managers with more alpha, and a lot less risk.

24.2.5.3 Why Low-Active-Risk Managers Are Preferred: Reason Number Two

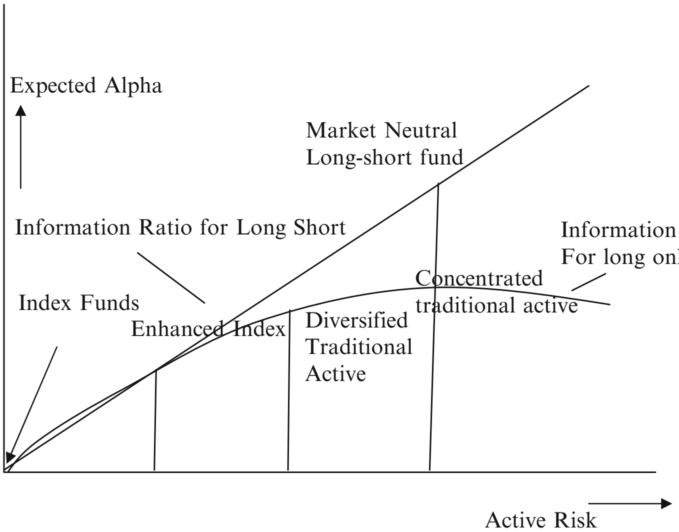
So far we've seen that for a group of managers with equal forecast information ratios, those with greater active risk will have smaller optimal holdings in the portfolio. But there is another effect to consider as well, one that also tends to diminish the size of allocations to managers that have greater active risk.

Most managers are prohibited by their mandates from taking short positions, and hold long-only portfolios. This limits a manager's ability to make bets on its insights, limitations that get exacerbated as active risk is ratcheted up, and requires larger and larger active positions. As a result, *even with skill levels held constant*, the information ratio that can be achieved goes down as a manager constructs a portfolio with greater concentration and active risk.[25] Exhibit 24.2 illustrates this concept.

What are these limitations? A skillful alpha forecasting process is as much at home generating sell signals (negative expected alphas) as buy signals (positive

[25] See Grinold and Kahn (2000b).

Exhibit 24.2 The impact of the long only constraint on portfolio efficiency



expected alphas). But few of the negative alphas can be acted on in a constrained, long-only portfolio. A given security can only be sold down from the benchmark weight to a zero weight, and not below, no matter how strong is the negative signal. The manager's insights are wasted, and the effect is greater as greater risk is taken on (bigger negative positions are indicated but can't be achieved without violating the constraint). The amount of alpha per unit of active risk thus goes down as the active risk level goes up, generating a declining information ratio for a constant level of skill. This effect is remarkably powerful: At a given skill level, enhanced-index funds and market neutral long-short funds are shown in a study by Kahn (2000) to have roughly *twice* as high an expected information ratio as their long-only, traditional active counterparts that have moderate risk.

So for an additional reason, higher-risk long-only active management is suboptimal. Again, "more juice?" Not. How about a high-protein shake?

24.2.5.4 How Much Active Risk Is Enough?

Since pure active risk (omega) is uncorrelated with policy risk, the relationship is Pythagorean, and total risk is less than the ordinary sum of policy and active risk and typically only slightly larger than policy risk alone. For example, if policy risk is 9% and the active risk is 3%, the total risk will be $\sqrt{9\%^2 + 3\%^2} = 9.5\%$. So total risk only goes up by 0.5% as a result of adding 3% risk from active management. Does this relatively small increment to total risk suggest that investors should take more active risk, choosing a more aggressive position on the active efficient frontier?

Good question. Theory doesn't give us much help in the practical domain of putting a value on the risk aversion term in any optimization. This term, called λ (lambda), determines how much risk an investor will take in search for the available expected return. We have to look at sources other than theory to get a proper sense for the appropriate ranges of active lambdas for investors.

One source to look at is our own behavior. Recalling the Brinson et al.(1986, 1991) studies and the other related articles cited earlier, about 90% of the variance – not the returns, the variance – of a typical portfolio's returns is attributable to SAA decisions (market risk), and only about 10% is attributable to active decisions (security selection and tactical asset allocation). What does this mean? Let's translate numbers that we know – from the familiar turf of standard deviation – into variance, to get a hint. An investor who takes policy risk with a 9% standard deviation (about mid-range) has a policy variance of 9% squared or 0.0081; if this same investor's active risk (standard deviation) is 3% then he or she has a 0.0009 active variance, smaller than the policy variance in the ratio of 90–10. Thus, Brinson's observed variance ratios (90–10%) are consistent with more or less ordinary standard deviation numbers (9% and 3%) for policy and active risk, respectively. In other words, investors, voting with their feet, reveal a preference for taking far less active risk than market risk. Why might this be? Some have asked the question, "if 'risk is risk,' why don't investors choose to take on the same amount of variance with respect to active bets as they do with market risk bets?" The answer has to go back to our motivating theme:

Policy bets are expected to be rewarded unconditionally, and proportionally to risk taken. Active bets are only rewarded conditionally on skill, and in a declining proportion to risk taken at that; they aren't rewarded at all on average. Thus, one kind of risk is more worth taking than the other. Put this way, it just makes sense that investors would give a higher risk budget to unconditionally expected *market* returns than to highly conditional and proportionally declining expected *alphas.*

We should almost certainly implement this observation by using a lambda risk aversion term that is higher when we are optimizing in the active risk dimension that when we are optimizing in the policy or SAA dimension. Thus, in Eq. (1), we indicated with the subscript α that the lambda is specifically an active-risk lambda, different from the lambda expressing aversion to policy risk. At the end of the day, the specific lambda used sets the "active risk budget," and the active risk budget has to be comfortable to the investor given that investor's perception of the alpha that he or she expects in return for taking on that risk.

24.2.5.5 Core-Satellite?

In the late 1980s, many investors started using the "core-satellite" concept. It was a way to temper the risk of an all-active portfolio. An indexed "core" was added to moderate the overall active risk of the portfolio. The concept was even used by some to justify holding extremely high risk, concentrated managers as the "satellites."[26] It made some sense at the time and represented some first stabs at controlling active risk.

But today's technology, particularly the ability to manage and optimize active risks and returns, allows us to reject the notion of the core-satellite portfolio as an all-too-rigid relic, once useful but which we've now grown beyond. For the same reasons that we are rejecting style buckets as insufficiently reflective of the continuous and scalar nature of managers' actual market exposures, the two buckets of "core" and "satellite" can be set aside also.

An optimally constructed portfolio of active managers is likely also to hold index funds. But as any active risk is contemplated, and if "good" low-risk active funds are available, the proportion held in index funds will rapidly shift to low-risk active funds. This shift will happen smoothly, not abruptly, with increasing risk. Further, the other active managers that are held will be more likely to have moderate risk levels than high risk levels.

And absent extraordinary skill levels, not really imaginable, the concentrated portfolio of "just 20 good stocks" is a dinosaur for the reasons discussed immediately above. The core-satellite paradigm is no longer useful when one conceives of manager selection as an optimization problem.

To illustrate this smooth shift among types of managers, examine the allocations at different risk levels in the example case in the Appendix.

It shows the allocations across a set of candidate managers including an equity index fund, a risk-controlled active manager, two traditional active managers, and a concentrated manager.

24.2.6 What Does a Portfolio That Reflects These Principles Look Like?

24.2.6.1 The "New Common Sense"

Having built the case for regarding manager structure and selection as an optimization problem, reflecting the reality of pure active return and risk as the real dimensions of active management, we can state what a portfolio reflecting these principles might look like. Moreover, a portfolio reflecting the principles we've advanced should have pretty much the same characteristics whether one formally optimizes or not. Not everyone has the time, focus, or patience to run an optimizer,

[26] As stated above, for a given level of skill, the information ratio must be lower for a concentrated high-risk active manager than for a lower-risk manager. And, of course, if the concentrated manager really is unskillful, its high risk level will mean that downside realization will be especially painful. On average, the highly concentrated manager performs at the average (before fees and costs – just like any other active manager).

and we're all equipped with pretty good "fuzzy optimizers" above our shoulders. For investors who use an actual optimizer and for those who don't, the following can inform one's intuition, providing common sense that is directed by the nature of the underlying optimization problem:

1. Be disciplined in forming expected alphas, and in giving the greater weights to managers with higher ratios of expected alpha over active risk squared. Be rigorous when examining *historic* alphas, looking for clues to the future. If a manager's alpha is not why are you looking at it, your final estimate of expected alpha should be strongly supported by fundamental analysis of the manager and its process.
2. The best portfolio is one that balances the two key dimensions of active management – maximizing pure active return and controlling the total active risk, summed across managers.
   (a) The portion of the portfolio that moderates its overall risk will consist of some combination of "good" risk-controlled active funds (sometimes called enhanced index funds) and traditional index funds, which together will likely comprise roughly one-third to two-thirds of the total fund. If an investor has little tolerance for active risk, this portion will lean more toward index funds; if there is more tolerance for active risk, it will lean toward risk-controlled active funds.
   (b) Risk-controlled active funds will be more heavily weighted than equally skillful traditional active funds at most risk levels chosen by institutional investors.
   (c) Among traditional active managers, prefer skillful lower-active-risk managers over higher-risk, concentrated managers. Bias toward diversified portfolios, away from concentration (unless completely carried away by the concentrated manager's extraordinary forecasting skill).
   (d) "Good" market-neutral long-short funds will receive a substantial weight for investors not limited to long-only managers. [27]
3. Set the overall active risk at a comfortable level, your "risk budget." For US equities, a typical investor seems to be most comfortable (in the experience of the authors) at an overall active risk level of 1.5–2%, with the very largest investors preferring even less active risk (between 0.75% and 1.25%).
4. Keep a careful eye on misfit risk, trying to minimize it while still maximizing expected alpha. If you don't use an optimizer designed especially for this purpose, you'll have to use a style map or "effective asset mix" table as a supporting tool.

[27] Alphas delivered by high information-ratio managers sourced in one asset class can, at least theoretically, be ported to another asset class (where, perhaps, high information-ratio managers are scarce) by the use of futures or other derivatives. Such a "portable alpha" strategy is most frequently used to add alpha, generated in hedge-fund programs, to an equity or fixed-income account.

24.3 Conclusion: Managing in the Right Dimensions

We recalled two “first principles” that emerged decades ago from the basic academic work in finance. The first is Harry Markowitz’ observation that investors should be concerned about risk as well as return, which he shaped into the mandate that investors build mean-variance efficient portfolios, using an optimizer. The second is William Sharpe’s demonstration that the total risk of an investment can be broken into policy risk, which is rewarded by the existence of an equity risk premium and active risk, which is a zero-sum game when summed across managers and thus not rewarded on average.

We added the observation that managers (being people) have skill levels that really do differ from one another. In addition, capital markets aren’t completely efficient. As a result, someone is going to win the active game due to real skill – not just luck or random variation – even while someone else is losing. It pays for the skillful investor to try to discern who will be the winners, giving active management a vital role in the portfolio.

We noted that while the payoff to market-related (policy) risk is linearly related to the amount of policy risk taken, that is not true of pure active risk, even conditional on the manager having real skill. Without skill there is no payoff for pure active risk. But in the presence of skill there is a payoff, one that declines as a proportion to pure active risk as the amount of risk taken increases (it does not decline for unconstrained, long-short strategies). We then tried to identify the logical consequences of this view of the world.

First, investors should build efficient, or optimized, portfolios of *managers* just as they should of asset classes (or securities within an asset class). Market or policy risk and return are commonly managed through the SAA process; we are suggesting that the active-risk decision across the portfolio of managers, being uncorrelated with policy, can and should be managed through its own separate optimization process.

To do so, investors must estimate the expected alpha (after fees and costs) for each manager.

Let’s spend a moment recalling the importance of this step. An investor must meet two conditions if he or she is to hire active managers.[28] First, one must believe that superior managers really do exist. That’s easy, if one accepts that managers differ in their skill levels. Second – this is the hard one – one must believe that he or she can identify which ones will be the winners. To accomplish this, one needs to be able to make specific alpha forecasts for managers, forecasts that are somewhat more right than wrong. If you can’t do that, you should just index. At ordinary risk levels, and with manager skill levels being generally equal, the optimization will give us a mix of index funds, risk-controlled active managers, equity market-neutral long-short funds, and moderate-risk traditional active managers. Most likely, it won’t give us more than light allocations to *concentrated* managers. At typical risk levels, it will favor lower active risk managers over higher risk managers. Second,

[28] See Waring et al. (2000), appendix C; and Waring et al. (2001).

investors should disentangle "pure alpha," the part of the active return that is the unique creation of the manager, from the various market factors that are in the manager's customized benchmark or "normal portfolio."

The manager's job is to beat this customized benchmark, not the naive asset-class return. Moreover, when investors make alpha forecasts for managers, it is this pure alpha that they should be forecasting. We can let the optimization process reduce the net misfit risk across all managers, balancing value managers appropriately against growth, and large-cap managers against small, so that the portfolio of managers looks as much like the investor's benchmark as is sensible. This is important; if the collection of the managers' market-related risks doesn't look like the benchmark, the investor's SAA policy has surreptitiously been changed.

Managing active managers in these dimensions is simpler than in conventional practice – we are dealing with risk and return, the basic building blocks of finance. Yet it is, at the same time, more complex: The difficult task of specifying scalar values for pure alpha and for misfit risk replaces the easier task of just filling out discrete style boxes. But the scalar approach is the only one that reflects reality; we don't want to pretend that the world is simple where it is complex and there are fine gradations. As Einstein said, "Everything should be made as simple as possible but no simpler."[29]

Active management offers the skillful an opportunity to influence the portfolio meaningfully by adding pure alpha. For those confident of their skill, the question is not *whether* to use active management, but *how*. Hard-working people have entrusted us, the community of investors, and asset managers, with trillions of dollars – basically, with much of their worldly goods. We owe them nothing less than the best application of sound financial knowledge that we can deliver. We know that the first principles synthesized here are valid, at least to the extent that today's understanding of economic science allows us to make such a claim. Let's apply these principles the best that we realistically can.

Plan sponsors hire active managers to generate "pure" active return or "pure" alpha (the portion of the return that is not explained by market or beta risk exposures of the portfolio), knowing that doing so will generate pure active risk. Building a portfolio of managers involves optimizing the trade-off between pure active return and active risk. Current practice typically draws only a fuzzy distinction between a manager's pure alpha and the market exposures (including style and other systematic risk factor exposures) delivered by that manager. By making this distinction clear, and by quantifying it, one can greatly improve the payoff to the decision to hire active managers. Existing practice for building portfolios of managers, such

[29] *Reader's Digest* (October 1977). Peter Neumann, who knew Einstein personally, writes (see *www.csl.sri.com/users/neumann/neumann.html*), "I was probably just one of many people who heard him say something like, 'Everything should be as simple as possible but no simpler' or 'Everything should be made as simple as possible but no simpler' . . . After his death, I asked Mrs. Dukas (his long-time assistant) if there was any record of such a statement in any of his writings (she was the one responsible for organizing all of his papers); she eventually responded that she was unable to find any written record attributable directly to AE."

as historical performance comparisons, style boxes, and heavy reliance on traditional active management, is not clearly focused on adding value to the portfolio. The process of building portfolios of managers can be better attuned to maximizing active return while controlling active risk. We suggest the following rules of thumb:

1. Be disciplined in forming expected alphas, and in giving the greater weights to managers with higher ratios of expected alpha over active risk squared. Be rigorous when examining historic alphas.
2. The portion of the portfolio that moderates its overall risk will consist of some combination of "good" risk-controlled active funds (index funds) and traditional index funds.

   Together, these should represent one-third to two-thirds of the total fund. Risk-controlled active funds will be more heavily weighted than equally skillful traditional active funds at most risk levels chosen by institutional investors. Among traditional active managers, prefer skillful lower active risk managers to higher risk, concentrated managers. Bias toward diversified portfolios. "Good" market-neutral long-short funds will receive a substantial weight for investors not limited to long-only managers.
3. Set the overall active risk at a comfortable level, your "risk budget." For US equities, a typical overall active risk level is 1.5% to at most 2%, with the very largest investors preferring even less active risk (between 0.75% and 1.25%).
4. Keep a careful eye on misfit risk, trying to minimize it while still maximizing expected alpha. If you don't use an optimizer designed especially for this purpose, you'll have to use a style map or "effective asset mix" table as a supporting tool. In short, for the plan sponsor confident of his or her skill at selecting managers, the question is not whether to use active management, but how. The plan sponsor's task is made harder by the fact that too often active managers "spin" their craft, creating a number of myths about active management in the process.

Appendix: MSO Example

This example shows a stylized MSO case. The alpha assumption is entirely artificial, assuming a constant pure information ratio of 0.05.

At a typical 2% active risk level, the optimal portfolio would be about half traditional active and half risk-controlled active, with no index fund. The declining holdings of index funds and their replacement by risk-controlled active funds demonstrates the point that we made in our section discussing core-satellite investing. Likewise the concentrated manager receives only a small allocation contrary to some core-satellite interpretations. To make the best possible case for using concentrated managers, we used the same information ratio of pure alpha to active risk for the concentrated manager as for the others. In the real world and assuming equal skill, the long only constraint would cause the concentrated manager's information ratio to be much lower than the others. So these small allocations are in reality much overstated.

Sponsor benchmark: Russell 3000 Broad Capitalization US Equity							
Manager assumptions			**Expected**		**Expected**		
Manager (style betas)			**Alpha (%)**		**Active risk (%)**		
Index fund (Russell 3000)			0		0		
Risk-controlled active manager			0.75		1.5		
Growth fund (80% R3 growth 20% R3 value)			2.5		5		
Value fund (20% R3 value 80% R3 growth			2.5		5		
Concentrated fund (Russell 3000)			9		18		
Capital Market Assumptions (based on 10 years of data 11/92–11/02)				**Corr.**			
Style index	Expected total risk (%)	R1G	R1V	R2G	R2V		
Russell 1000 growth	19.39	1					
Russell 1000 value	14.11	0.7	1				
Russell 2000 growth	25.44	0.78	0.49	1			
Russell 2000 value	14.24	0.55	0.7	0.76	1		
Equity benchmark (Russell 3000)		46.60%	46.60%	3.40%	3.40%		
Optimal manager allocations			**Active risk budget (%)**				
	0	0.5	1	1.5	2	2.5	3
Index fund	100	72.2	44.4	15.8	0	0	0
Risk-controlled active manager	0	16.5	33	50	52.5	38.7	17.2
Traditional active: total	0	11.3	22.6	34.2	47.5	61.3	82.8
Growth fund	0	5	9.9	15	20.7	26.4	35.2
Value fund	0	5	9.9	15	20.7	26.4	35.2
Concentrated fund	0	1.4	2.8	4.2	6.2	8.6	12.4

References

Banz RW (1981) The relationship between return and market value of common stocks. J Financial Econ 9:3–18

Basu S (1977) Investment performance of common stocks in relation to their price-earnings rations: a test of the efficient market hypothesis. J Finance 32(3):663–681

Basu S (1983) The relationship between earning's yield, market value and return for NYSE common stocks. J Financial Econ 12:129–156

Bell ET (1952) Mathematics, queen and servant of the sciences. Mathematical Association of America, Washington, DC, Reprint 1987

Brinson GP, Hood LR Jr, Beebower GL (1986) Determinants of portfolio performance. Financial Anal J (July/August):39–44

Brinson GP, Singer BD, Beebower GL (1991) Determinants of portfolio performance II: an update. Financial Anal J 47(3):40–48

Carhart MM (1997) On persistence in mutual fund performance. J Finance 52:57–82

Evans LJ, Archer NS (1968) Diversification and the reduction of dispersion: an empirical analysis. J Finance 23(5):761–767

Fama EF, French KR (1993) Common risk factors in the returns on stocks and bonds. J Financial Econ 33(1):3–56

Grinold RC (1990). The sponsor's view of risk. In: Fabozzi FJ (ed) Pension fund investment management: a handbook for investors and their advisors. Probus, Chicago

Grinold RC, Kahn RN (2000a) Active portfolio management, 2nd edn. McGraw-Hill, New York

Grinold RC, Kahn RN (2000b) The surprisingly large impact of the long-only constraint. Invest Insights 3(2). Barclays Global Investors, San Francisco

Grinold RC, Kroner KF (2002) The equity risk premium. Invest Insights 5(3). Barclays Global Investors, San Francisco

Ibbotson RG, Kaplan PD (2000). Does Asset Allocation Policy Explain 40%, 90% or 100% of Performance? Financial Anal J Jan–Feb:26–33

Kahn RN (2000) Most pension plans need more enhanced indexing. In: Brian R. Bruce (ed) Enhanced indexing: new strategies and techniques for investors. Institutional Investor, Investment Guides, New York

Kahn RN, Rudd A (1995) Does historical performance predict future performance? BARRA Newslett (Spring). Available online at www.barra.com/research/BarraPub/hpp-n.asp

Kritzman MP (2000). Half stocks all the time or all stocks half the time. In puzzles of finance. Wiley, New York

Kritzman MP (2003) Value in – garbage out. Economics and portfolio strategy. Peter L. Bernstein, New York

Leibowitz ML et al (2001) At the equity risk premium forum (November 8, 2001) Sponsored by the Association for Investment Management and Research, Charlottesville, VA. Available online at www.aimrpubs.org/ap/issues/v2002n1/pdf/v2002n1.pdf

Markowitz HM (1952, 1991). Portfolio Selection: Efficient Diversification of Investments, 1st edn. 1959; 2d edn. 1991. Basil Blackwell, Oxford. First Published in Journal of Finance (March 1952)

Michaud RO (1989) The Markowitz optimization enigma: is 'optimized' optimal? Financial Anal J 45:31–42

Michaud RO (1998) Efficient asset management. Harvard Business School, Boston

Reinganum MR (1981) Misspecification of capital asset pricing: empirical anomalies based on earnings' yields and market values. J Financial Econ 9:19–46

Ross SA (1976) The arbitrage theory of capital asset pricing. J Econ Theory 13(3):341–360

Sharpe WF (1964) Capital asset prices: a theory of market equilibrium under conditions of risk. J Finance (September):425–442

Sharpe WF (1974) Imputing expected security returns from portfolio composition. J Financial Quant Anal (June):463–472

Sharpe WF (1988) Determining a fund's effective asset mix. Invest Manage Rev 2(6):59–69 (corrected version)

Sharpe WF (1991) The arithmetic of active management. Financial Anal J (January/February)

Sharpe WF (1992) Asset allocation: management style and performance measurement. J Portfolio Manage 18(2):7–19

Sikorsky S (2003) Igor Sikorsky. AOPA Pilot (February):138

Surz RJ, Stevens D, Wimer M (1999) The importance of investment policy. J Invest (Winter):80–85

Taleb NN (2001) Fooled by randomness. Texere, New York

Waring MB, Whitney D, Pirone J, Castille C (2000) Optimizing manager structure and budgeting manager risk. The Journal of Portfolio Management (Spring)

Waring MB, Harbert LD, Siegel LB (2001) It's 11 P.M.—Do you know where your employees' assets are?" Invest Insights 4(2)

Wermers R (2000) Mutual fund performance: an empirical decomposition into stock-picking talent, style, transaction costs, and expenses. J Finance (August). Barclays Global Investors, San Francisco

Chapter 25
Measuring Mutual Fund Performance

S.R. Vishwanath

25.1 Chapter Introduction and Objectives

As the global asset management industry has grown enormously in size, investors need sound measures of fund performance to compare the performance of various funds. The performance measurement industry itself has grown in popularity. Morningstar and Lipper Analytical Services lead the industry in the USA. Such services have emerged in other parts of the world as well. In this chapter, we provide an overview of various approaches to measuring fund performance.

This chapter has the following objectives:

- Describe the measurement of return and risk of a fund.
- Describe how value at risk (VaR) can be calculated for funds.
- Compare and contrast popular measures of fund performance like Sharpe ratio, Modigliani measure, Treynor's ratio, and Jensen's alpha.
- Describe Morningstar's Star rating system.

As pointed out in the overview chapter on mutual funds, they are now the preferred way for individual investors and many institutions to participate in the capital markets, and their popularity has increased demand for evaluations of fund performance. Many business publications now rank mutual funds according to their performance, and information services exist specifically for this purpose. There is no general agreement, however, about how best to measure and compare fund performance and on what information funds should disclose to investors.

Risk and performance measurement is an active area for academic research and continues to be of vital interest to investors who need to make informed decisions and to mutual fund managers whose compensation is tied to performance. This chapter describes a number of performance measures. Their common feature is that

S.R. Vishwanath
Emirates Institute for Banking and Financial Studies, P.O. Box 4166, Sharjah, UAE
e-mail: srvishy@gmail.com

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_25,

they all measure funds' returns relative to risk. However, they differ in how they define and measure risk and, consequently, in how they define risk-adjusted performance.

If one were to believe the advertisements in the print and television media about past returns and star rating, one would be convinced that there are hundreds of funds that can claim great performance. This is not the case whether it is in the USA or any other country. While it is important to consider measures of past performance, one should evaluate that performance against the market and economic environments. If the fund invests in stocks that are typically cyclical in nature (e.g., automobile and housing stocks), the fund's recent performance may reflect the height of a cycle and not the future downturn of the business cycle. In addition, market volatility may affect short-term performance.

Although past performance is certainly not an indication of future results, there are some clues to be found about the quality of a fund by *correctly* measuring its past performance. Usually, what will be discerned through a careful study of past performance is that not many mutual funds actually deliver anything close to what their advertisements claim.

In the following sections, we describe:

- Simple measures of fund return
- Measures of risk
- Risk-adjusted performance, and
- Measures of risk and return based on modern portfolio theory

25.2 Measures of Return

A 10% investment return is good news to most mutual fund investors. But it could be a high return or a disappointment depending on the type of fund and the market environment. But how can you tell for sure? In other words, how high is high? To answer this question, fund returns are to be compared with a benchmark. When reviewing a mutual fund's historical performance, it is important to consider the following:

- Total return
- Performance against benchmark index
- Performance against peers

As with other investments, one measures a mutual fund's past performance in terms of "total return." Total return is the combination of any income from interest, dividends, and capital gains during a period, plus any gain or loss in net asset value (NAV) over that time.

Total return = income + dividends + capital gains + gain (loss) in NAV[1]

[1] The net asset value (NAV) is the share price of the fund, obtained by dividing the value of the fund's holdings by the number of outstanding shares. The share price is what you would have to

A fund's monthly return, say, can be expressed as:

$$R_t = \frac{\mathrm{NAV}_t + \mathrm{DIST}_t - \mathrm{NAV}_{t-1}}{\mathrm{NAV}_{t-1}}$$

where R_t is the return in month t, NAV_t is the closing net asset value of the fund on the last trading day of the month, NAV_{t-1} is the closing net asset value of the fund on the last day of the previous month, and DIST_t is income and capital gains distributions during the month.

The return is calculated net of management fees and other expenses.

25.2.1 Arithmetic Versus Geometric Averaging

In calculating or reporting fund performance, past returns are averaged. Two types of averaging are possible. To calculate the arithmetic average, daily, weekly, or monthly, returns are calculated for some period of time (say 1 year) by taking the sum of the individual interval returns and dividing by the number of intervals in a year. The arithmetic average is then annualized by multiplying this number by the number of days, weeks, or months in a year.

Let us suppose the cumulative 5 years return of a fund is 50%. Its annualized compounded return is:

$(1.50)^5 - 1.00$

That is, because of compounding, the arithmetic average of, say, monthly returns for a period of time is not the same as the monthly rate of return that would have produced the total cumulative return during that period.

In general, the geometric mean of returns

$$R_{\mathrm{g}} = [(1+R_1)(1+R_2)(1+R_3)\ldots(1+R^N)]^{1/N} - 1$$

The arithmetic average is higher than the geometric average and the difference increases with the standard deviation of fund's returns.

25.2.2 Total Return Versus Alpha

As pointed out earlier, an 8 or 10% itself does not convey much about the performance a fund unless it is compared with an alternative investment.

---

pay to buy into the mutual fund, plus any fees. The change in NAV, reported at the end of every market day, reflects the increase or decrease in the value per share.

NAV = Value of fund/number of shares

If, for example, the value of fund is $100,000,000 and 10,000,000 shares are outstanding, the NAV is $10 per share.

As a starting point one may compare the monthly return of a fund with the risk free rate (i.e., 90 day T Bill). One may then calculate the excess return – the difference between the fund's return and the risk free rate – as well as the annual geometric mean return. Since mutual fund investments are risky it is more appropriate to compare their performance with investments of similar risk.

Mutual funds are required to compare their performance to an independent measure called a *benchmark* – an index that measures the performance of a portfolio of similar securities. A core stock fund, for example, might compare its performance to the S&P 500 index, a broad measure of the performance of 500 large American companies – the same universe a core fund manager would target. There are different benchmarks for different types of funds – bond funds and international funds, big funds and small funds, closed-end and open-end funds. A fund's target benchmark can usually be found in the prospectus. A large cap stock fund's performance may be compared with that of DJIA index or the S&P 500. Likewise, the performance of mid cap stock funds can be compared with S&P Mid Cap 400 index. Given below is a list of benchmarks:

Large Cap Stock Funds	Dow Jones Industrial Average index[2]
	S&P 500 index[3]
Mid Cap Stock Funds	S&P Mid Cap 400 index[4]
Small Cap Stock Funds	Russell 2000 index[5]
Total Stock Market Funds	Russell 3000 index[6]
Taxable Bond Funds	Lehman Brothers aggregate bond index[7]
Municipal Bond Funds	Lehman Brothers municipal bond index[8]
International Stock Funds	MSCI EAFE index[9]

The amount by which the fund has outperformed or underperformed its investment benchmark is the fund's alpha. Thus, if a fund has earned 20% during a particular period and the S&P 500 return for the same period is 22%, the fund's alpha is -2%.

[2] The DJIA index is a price-weighted average of 30 actively traded blue chip companies.

[3] The S&P 500 index is a widely recognized, unmanaged index of 500 publicly traded stocks that includes the reinvestment of dividends.

[4] The S&P Mid Cap 400 index is an unmanaged index that consists of 400 domestic (US) stocks chosen for market size, liquidity, and industry group representation.

[5] The Russell 2000 index in an unmanaged index that measures the performance of the 2,000 smallest companies in the Russell 3000 index, which represents approximately 8% of the total market capitalization of the Russell 3000 index.

[6] An unmanaged index that measures the performance of the 3,000 largest US companies which represents approximately 98% of the investable US equity market.

[7] An unmanaged index that tracks the total US bond market, which includes US Treasury, government agency, investment-grade corporate bond, and mortgage-backed securities with maturities of at least 1 year. The index includes reinvestment of interest.

[8] An unmanaged index considered the total return performance benchmark for the long-term investment-grade tax-exempt bond market. The index includes reinvestment of interest.

[9] The MSCI Europe, Australasia, Far East (EAFE) Index is an unmanaged, free float-adjusted market capitalization index that is designed to measure developed market equity performance, excluding the USA and Canada.

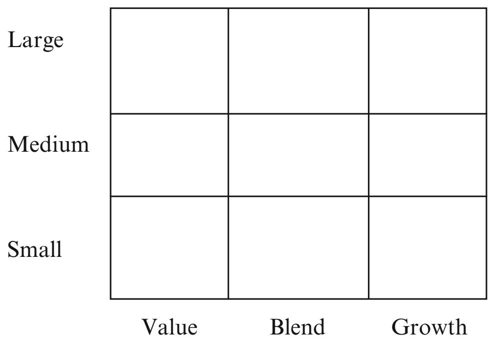
Measuring a fund's return against an index has its shortfalls: indices are unmanaged and do not reflect the payment of advisory fees and other expenses associated with an investment in a mutual fund. Investors cannot directly invest in an index. An index does not pay operating and management expenses, and it does not have to keep any cash on hand for liquidity. That is why funds also compare themselves to a peer group of funds that share similar characteristics. Relevant benchmarks include bond investments of a particular maturity range, large or small cap stocks, or sector/geography-specific funds.

Two well-known companies, Lipper and Morningstar, track mutual fund performance information and compute the average return for each group of funds so that shareholders can compare a fund's return to the average.[10]

Morningstar, a premier mutual fund data source, has created a style box has to help investors with their asset allocation strategies. The style box categorizes funds into these nine categories:

- Small value
- Small blend
- Small growth
- Medium value
- Medium blend
- Medium growth
- Large value
- Large growth
- Large blend

Given below is the Morningstar style box.



Morningstar measures a fund's market capitalization (large, medium, and small) by studying the size of the companies that the fund is investing in. The top 5% of the 5,000 largest stocks are classified as large cap, the next 15% are considered medium cap, and the remaining 80% are considered small cap.

Using price to earnings (P/E) and price to book (P/B) ratios of the companies a fund invests in, Morningstar analyzes the data to determine if a fund is a value, growth, or blend (meaning a mixture of the two) fund.

[10] The Morningstar star rating is discussed in Sect. 25.5.

There are many different ways to use the style box to make your asset allocation selection. Investment professionals have different recommendations on how to use the style box. Some will recommend you purchase a fund for each category, others will recommend a single medium blend fund. Once you know which "style box" a fund is in, you can compare it with the other mutual funds that are similarly classified, and in many cases to a relevant index fund. Going through this exercise and comparing a fund's returns over 3, 5, and 10 years with the appropriate market index and other similarly styled funds will be much more useful than simply comparing a fund's returns to the S&P 500 or seeing how many stars it has. While the S&P 500 is a very useful benchmark for the market as a whole, you will get a much better idea about a specific fund's relative merits by comparing it with its style box competition than you will by comparing it with the market as a whole or the S&P 500 in particular. In 1998, for example, approximately 90% of all mutual funds lost to the returns of the S&P 500. S&P 500 index funds are categorized by Morningstar as "large-cap blend" funds, meaning that the S&P 500 is dominated by neither growth stocks nor value stocks.

25.3 Measures of Risk

As pointed out in the chapter on risk and return, investors are interested not only in a fund's returns but also in risks associated with achieving them. Financial theory defines risk as the possibility that actual returns will deviate from expected returns. The degree of potential fluctuations determines the degree of risk.

25.3.1 Standard Deviation

More specifically, the risk in holding a fund is the variance in expected returns. The variance in returns measures the disparity between actual and expected returns. Modern finance theory hypothesizes that investors choose securities on the basis of expected return and standard deviation (square root of variance). So given a choice between two investments with same expected return, the investor would choose the one with lower standard deviation.

The standard deviation of monthly returns for a mutual fund can be measured as:

$$\text{Standard deviation} = \frac{\sqrt{1}}{T}\Sigma(R_t - \text{AR})^2$$

where AR is the average monthly return and T is the number of months in the period.

The standard deviation can also be calculated for excess returns (over risk free rate). Likewise, the standard deviation of excess returns over a benchmark index can also be calculated. This is sometimes referred to as "tracking error" because it is a measure of a fund's ability to track a particular index that is closest to its purpose.

The monthly standard deviation is annualized by compounding.

The standard deviation captures both upside potential and downside risk. But the investor is considered with only the former. The downside risk is simply half the total variability. Consequently, measuring standard deviation serves our purpose if fund returns are assumed to be normally distributed.

Another approach is to take into account only losses but not gains. That is, take into account only those periods (say months) in which a fund had negative excess return, sum up the negative returns and divide this sum by the total number of periods (months). Downside risk and standard deviation are usually highly correlated because monthly stock returns are normally distributed.

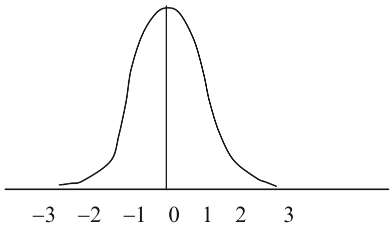
25.3.2 Value at Risk

The standard deviation loses its appeal for two reasons. First, managers think of risk in terms of dollars of loss, whereas standard deviation defines risk in terms of deviations, either above or below expected return and is therefore not intuitive. Second, in trading portfolios, deviations of a given amount below expected return do not occur with the same likelihood as deviations above, as a result of positions in options and option-like instruments, whereas the use of standard deviation for risk management assumes symmetry. An alternative measure of risk was therefore required. Why not measure the spread of returns, then, by estimating the loss associated with a given, small probability of occurrence? Higher spread, or risk, should mean a higher loss at the given probability. Then senior management can be told that there is 1 in 100, say, chance of losing X dollars over the holding period. Not only is this intuitively appealing, but it is easy to show that when returns are normally distributed (symmetric), the information conveyed is exactly the same as were standard deviation employed, it is just that the scale is different. This approach is consistent with Modern Portfolio Theory. This is precisely what VaR captures.[11]

VaR is a measure of how the market value of an asset or of a portfolio of assets is likely to decrease over a certain time period (usually over 1 day to 2 weeks) under usual conditions. It is typically used by security houses or investment banks to measure the market risk of their asset portfolios, but is actually a very general concept that has broad application. *Market risk* is usually defined as the risk of loss in a financial instrument from an adverse movement in market prices or rates. Depending on the instrument and position, a rise or fall in prices and rates would be adverse. If you own a bond, then a rise in interest rates is adverse, but if you have sold a bond, it is a fall in rates that is adverse. Generally people classify sources of market risk into four categories: interest rates, equities, foreign exchange, and commodities.

[11] The literature on VaR is vast. A good book on the topic is Jorion, Philippe, Value at Risk: The New Benchmark for Managing Financial Risk, McGraw Hill 2000.

Exhibit 25.1 Three sigma limits on a normal distribution



VaR is an estimate of the level of loss on a portfolio which is expected to be equaled or exceeded with a given, small probability. VaR is a measure of potential loss from an unlikely, adverse event in a normal, everyday market environment. VaR is denominated in units of a currency, for example, US dollars. To get more concrete, VaR is an amount, say *D* dollars, where the chance of losing more than *D* dollars is, say, 1 in 100 over some future time interval, say 1 day. This is a probabilistic statement, and therefore VaR is a statistical measure of risk exposure. The calculation of VaR requires the application of statistical theory.

An example will clarify the concept. Assume that you have invested \$2,000 in a fund and wish to estimate VaR for this investment over the next 1 month. Further assume that the fund's returns are normally distributed. Recall from the chapter on risk and return that one of the properties of normal distribution is that 95% of all observations occur within 1.96 standard deviations from this mean. This implies that the probability that an observation will fall 1.96 standard deviations below the mean is only 2.5% (we are interested only in losses, not gains). If the fund's average monthly return is 2% and the standard deviation is 3%, its monthly VaR at the 2.5% probability level is:

$$2\% - 1.96(3) = -3.88\% \text{ or } \$77.60 \text{ for a } \$2000 \text{ investment.}$$

To sum up, the probability of losing more than \$77.60 is 2.5%.

The 1, 2, and 3 sigma limits and the associated area under the normal distribution are shown in Exhibit 25.1.

Originally VaR was used as an information tool, that is, it was used to communicate to management a feeling for the exposure to changes in market prices. Then market risk was incorporated into the actual risk control structure, that is, trading limits were based on VaR calculations. Now it is commonly used in the incentive structure as well. That is, VaR is a component-determining risk-adjusted performance and compensation.

25.3.3 VaR Methodologies

The general approaches to VaR computation have fallen into three classes called variance/covariance, historical simulation, and Monte Carlo.

The *variance/covariance method* is most closely tied to Modern Portfolio Theory, as the VaR is expressed as a multiple of the standard deviation of the portfolio's return. J P Morgan's Riskmetrics Package uses this approach. To calculate VaR under this approach:

- Use the historical data to calculate the mean, variance, and correlations of each asset. Each asset's return is assumed to be normally distributed with its own mean and variance.
- We know that the variance of a two-asset portfolio can be calculated as:

$$\begin{aligned}\sigma_p^2 &= X_1^{2*}\sigma_1^2 + X_2^{2*}\sigma_2^2 + 2X_1{}^*X_2{}^*\mathrm{Cov}_{12}\\ &= X_1{}^{2*}\sigma_1^2 + (1-X_1)^{2*}\sigma_2^2 + 2X_1{}^*(1-X_1)^*\rho_{12}^*\sigma_1{}^*\sigma_2\end{aligned}$$

  where X_1 and X_2 are weights for the two assets and expected return is the weighted average of the returns of two assets.
- Assume that the return on the portfolio is normally distributed. As pointed out earlier, 95% of the values lies within 1.65 standard deviations from the mean. Therefore, the VaR will lie -1.65 standard deviations away from expected return at a 95% confidence level. Similarly, VaR is the value on the distribution 2.33 standard deviations on the left of the mean.

Assume the following data:

$X_1 = 0.5$
$\sigma_1 = 0.05$
$\sigma_2 = 0.04$
$E(R_1) = 19\%$
$E(R_2) = 17\%$
$\mathrm{Cov} = 0.02$
$E(R_P) = 0.5 \times 19 + 0.5 \times 17 = 18\%$
Variance of portfolio $= (0.0025 \times 0.25) + (0.0016 \times 0.25) + 2 \times 0.5 \times 0.5 \times 0.02 = 0.000625 + 0.0004 + 0.01 = 0.011$
Standard deviation $= 0.105$

The 5% tail on the left (at 95% confidence level) is $1.65 \times 0.105 = 0.173$ away from the mean.

The 95% confidence level of VaR is $0.18 - 0.173 = 0.007$. That is, there is a 5% chance that the portfolio will lose more than 0.7%.

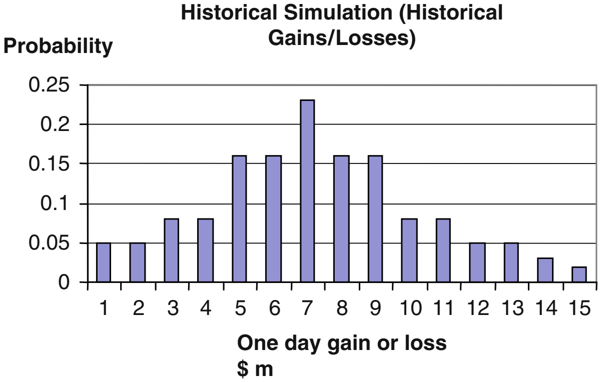
This method gets more complex as the number of assets increases as it requires the mean returns and covariance matrix of asset returns.

The variance–covariance approach has some limitations:

- It assumes all risk factors are normally distributed.
- It does not capture nonlinear payout functions like options.
- It assumes a static portfolio.

Historical simulation, unlike the variance–covariance approach, does not depend on calculated correlations and volatilities. It uses historical data of actual price

Exhibit 25.2 Historical simulation of portfolio gains and losses



movements to determine the actual portfolio distribution. It expresses the distribution of portfolio returns as a bar chart or histogram of hypothetical returns. Each hypothetical return is calculated as that which would be earned on today's portfolio if a day in the history of market rates and prices were to repeat itself. That is, historical VaR is calculated by mapping a portfolio into a historical price distribution. The gains and losses are then added across the portfolio for each day and then ranked in order. The VaR then is read from this histogram. If the confidence level is 95% and there are 600 data points, we would select the 30th lowest return ($5\% \times 600 = 30$). A hypothetical historical simulation of gains and losses on a portfolio is presented in Exhibit 25.2.

Monte Carlo also expresses returns as a histogram of hypothetical returns. In this case, the hypothetical returns are obtained by choosing at random from a given distribution of price and rate changes estimated with historical data. Under this methodology, the theoretical probability distribution of changes in value for each financial instrument is calculated for the desired time horizon (say, 10 days) as per the distribution parameters specified in the simulation. The theoretical changes are then added to today's value and arrayed as in the case of historical VaR to produce the desired confidence interval VaR.

Monte Carlo simulation models the changes in *risk factors* rather than changes in individual assets.

The following steps are involved in Monte Carlo simulation:

1. Decide on N, the number of iterations to perform.
2. For each iteration

   - Generate a random scenario of market moves using some market model.
   - Revalue the portfolio under the simulated market scenario.
   - Compute the portfolio profit or loss under the simulated scenario (i.e., subtract the current market value of the portfolio from the market value of the portfolio computed in the previous step).

3. Sort the resulting profit and losses to give us the simulated profit and loss distributed portfolio.

4. VaR at a particular confidence level is calculated using the percentile function. For example, if we computed 2,500 simulations, our estimate of the 95% percentile would correspond to the 125th largest loss ($= 0.05 \times 2500$).

Each of these approaches has strengths and weaknesses. The principal virtue of the variance–covariance approach lies in speed in computation. The quality of the VaR estimate degrades with portfolios of nonlinear instruments. Departures from normality in the portfolio return distribution also represent a problem for the variance–covariance approach. Historical simulation is free from distributional assumptions, but requires the portfolio be revalued once for every day in the historical sample period. Because the histogram from which the VaR is estimated is calculated using actual historical market price changes, the range of possible portfolio value changes is limited. Monte Carlo VaR is not limited by price changes observed in the sample period because revaluations are based on sampling from an estimated distribution of price changes. Monte Carlo usually involves many more repricings of the portfolio than historical simulation and is, therefore, the most expensive and time-consuming approach.

The calculations involved in each methodology are given below:

Methodology	Calculations
Variance–covariance	Volatility and correlation matrix
	Matrix algebra to arrive at VaR
Historical simulation	Historical data set
	Simulate portfolio using historical returns as actual distribution
Monte Carlo simulation	Volatility and correlation matrix
	Monte Carlo simulation to generate portfolio return distribution

To calculate VaR, one has to decide the time horizon, confidence interval, data series, and selection of risk factors. The choice of time horizon depends on the objectives of the portfolio and liquidity of its position. Typically VaR is computed using a 1-day, 1-week, or 2-week time horizon for trading and market making operations. Firms that hold illiquid positions may choose a longer time horizon. It is common to use confidence intervals ranging from 90 to 99%, although the Bank for International Settlements prescribes 99% confidence level.

The VaR estimate is sensitive to the data used. In particular, one has to choose between longer periods of data (which results in a richer distribution) and shorter periods (which could result in loss of important information) as well as between historical and implied correlations and volatilities.

25.3.4 Limitation of VaR

VaR is actually a piece of information about the distribution of possible future losses on a portfolio. The actual gain or loss won't be known until it happens. Until then it is uncertain, a random variable. Information about the behavior of a random variable is called a statistic. As you may guess, there are many statistics about a portfolio returns, for example, the expected return. The VaR is a very useful statistic for risk managers, but it is unlikely that it is the only statistic that has some usefulness. Nevertheless, it is the statistic focused on almost exclusively.

VaR itself is a random variable because not only is the portfolio's future return unknown, but the distribution of the portfolio's return must be guessed at by inference from observable data. That means that the calculated VaR is really itself just an estimate of the true VaR. So you could estimate a VaR of the distribution of the VaR! Most people are content with estimating confidence intervals for any estimated parameter because the confidence interval tells you how precise is your estimate.

25.4 Risk-Adjusted Performance

As pointed out earlier, fund returns are not to be viewed in isolation; they derive meaning only when adjusted for risk. Depending on the definition of risk, several measures like the Sharpe ratio, Modigliani Measure, Jensen's alpha, and Treynor's ratio can be calculated to assess the performance of a fund. In this section, we describe these. We also describe the Morningstar approach for rating mutual funds.

25.4.1 Using Sigma to Measure Risk-Adjusted Returns: The Sharpe Ratio

The Sharpe ratio was developed by Nobel Laureate William F. Sharpe to measure the risk-adjusted performance of a portfolio (Sharpe 1966, 1994). It is calculated by subtracting the risk-free rate from the rate of return for a portfolio and dividing the result by the standard deviation of the portfolio returns.

$$\text{Sharpe ratio} = \frac{R_\text{p} - R_\text{f}}{\sigma_\text{p}}$$

The Sharpe ratio tells us whether the returns of a portfolio are due to smart investment decisions or a result of excess risk. This measurement is very useful because although one portfolio or fund can reap higher returns than its peers, it is only a good investment if those higher returns do not come with too much additional risk. The greater a portfolio's Sharpe ratio, the better its risk-adjusted performance has been.

Most performance measures are computed using historic data but used for forward looking decision making. That is, we look at past performance and make inferences about future.

There are two versions of the Sharpe ratio: ex ante (i.e., expected) and ex post (i.e., historic).

To calculate ex post Sharpe ratio:

1. Calculate the differential return between the portfolio return and the benchmark return over some historic time period (e.g., months).
2. Calculate the arithmetic mean of the differentials.
3. Calculate the standard deviation of the differential return.
4. Divide the mean by the standard deviation.
5. Standardize the result by annualizing.

To illustrate, assume that a fund's arithmetic monthly mean excess return is 1.5%, while the monthly standard deviation of its excess return is 3.0%. Thus, the monthly Sharpe ratio is $1.5\%/3.0\% = 0.50$. The annualized Sharpe ratio is computed as the ratio of annualized mean excess return and its annualized standard deviation. It can also be calculated as the monthly Sharpe ratio times the square root of 12. Thus, the annualized Sharpe ratio in this case is 1.73.

The benchmark for the Sharpe ratio is usually a riskless security. But it is also possible to utilize a benchmark portfolio designed to have a set of investment style similar to that of the fund being evaluated. In such cases, the differential return represents the difference between the return on the fund and the return that would have been obtained from a similar passive alternative. The difference between the two returns is attributed to active management or stock selection. This general version of the Sharpe ratio is termed "information ratio."

A variation of the Sharpe ratio is the Sortino ratio developed by Frank Sortino that removes the effects of upward price movements on standard deviation to instead measure only return against downward price volatility:

$$\text{Sortino ratio} = \frac{R_{\text{p}} - R_{\text{f}}}{\sigma_{\text{d}}}$$

where σ_{d} is the standard deviation of negative asset returns.

Treynor's Measure: Another widely used performance measure is Treynor's (proposed by Jack Treynor) measure, which is computed by formula:

$$\text{Treynor's measure} = \frac{R_{\text{p}} - R_{\text{f}}}{\text{Beta}}$$

As we see Treynor's measure is similar to Sharpe's measure except denominator, where standard deviation is replaced by systematic risk measure Beta, which reflects behavior of investment correlated to market index.

25.4.2 Using Sigma to Measure Risk-Adjusted Returns: The Modigliani and Modigliani Measure

Like the Sharpe ratio, the risk-adjusted performance measure suggested by Modigliani is based on the fund's return, the risk free return, and the standard deviation of excess returns (Modigliani and Modigliani 1997).

It focuses on total volatility but the risk-adjusted return is, essentially, a differential return relative to the benchmark returns.

The measure takes into account the fund's average return and determines what it would have been if the fund under consideration had the same degree of total risk as the market portfolio (i.e., S&P).

The Modigliani and Modigliani measure can be expressed as:

$$\text{Risk - adjusted performance} = \frac{\text{Fund's average excess return}}{\text{Standard deviation of fund's excess return}} \times (\text{SD of index excess return})$$

Thus, if the annualized mean excess return of a portfolio, the standard deviation of excess return on the portfolio, and the standard deviation of index excess return are 19, 12, and 15%, the Modigliani measure is $(19\%/12\%) \times 15\% = 23.75\%$.

The RAP measure is the percent return an investor can earn in a fund if it had the same risk as the market index.

$$\text{RAP} = R_{\text{P}*} - R_{\text{M}}$$

To calculate RAP, the first step is to generate a (hypothetical) adjusted portfolio P*.

This portfolio is made of two parts:

- the managed portfolio P and
- a position in risk free asset (T Bills) in a way that the total volatility of the adjusted portfolio matches the market index's volatility.

To achieve the same degree of volatility as the index, funds with greater volatility than the benchmark are combined with cash, while funds with less volatility are leveraged.

Assume the following data:

$$\sigma_{\text{P}} = 42\%,\ \text{M} = 30\%,\ \text{R}_{\text{f}} = 6\%, \text{R}_{\text{P}} = 35\%,\ \text{and } \text{R}_{\text{M}} = 28\%$$

The adjusted portfolio will be formed by mixing the managed portfolio and T bills in the following way:

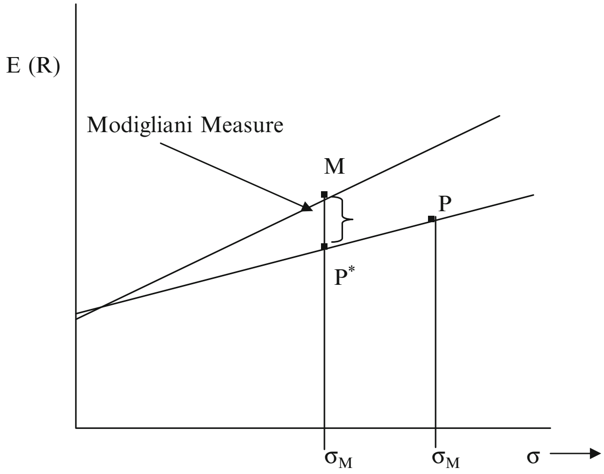
- Weight of $30/42(\text{i.e.}, \sigma_{\text{M}}/\sigma_{\text{P}}) = 71.4\%$ in portfolio P
- $100\% - 71.4\% = 28.6\%$ in T Bills

The expected return of the adjusted portfolio is $(0.714 \times 35\%) + (0.286 \times 6\%) = 24.99 + 1.716 = 26.7\%$

The fund has underperformed to the extent of $28\% - 26.7\% = 1.3\%$.

The Modigliani measure can be shown on a graph (Exhibit 25.3).

Exhibit 25.3 Modigliani measure



25.4.3 *Using Beta to Measure Risk-Adjusted Return: Jensen's Alpha*

From the capital asset pricing model (CAPM) we know that the expected return on a stock or a portfolio of stocks is a function of its beta.

$$E(R) = R_{\mathrm{f}} + \beta[E(R_{\mathrm{M}}) - R_{\mathrm{f}}]$$

Jensen's Alpha is a risk-adjusted performance measure that represents the average return on a portfolio over and above that predicted by the CAPM, given the portfolio's beta and the average market return. This is the portfolio's alpha.

$$\alpha_{\mathrm{P}} = r_{\mathrm{P}} - [R_{\mathrm{f}} + \beta_{\mathrm{P}}(r_{\mathrm{M}} - r_{\mathrm{f}}]$$

where r_{P} is the portfolio return, β_{P} the beta of the portfolio, r_{M} the expected market return, and r_{f} the risk free rate.

The basic idea is that to analyze the performance of an investment manager one must look not only at the overall return of a portfolio but also at the risk of that portfolio. For example, if there are two mutual funds that both have a 12% return, a rational investor will want the fund that is less risky. Jensen's measure is one of the ways to help determine if a portfolio is earning adequate return for its level of risk. If the value is positive, then the portfolio is earning excess returns. In other words, a positive value for Jensen's alpha means a fund manager has "beat the market" with his or her stock picking skills.

Consider the following data:

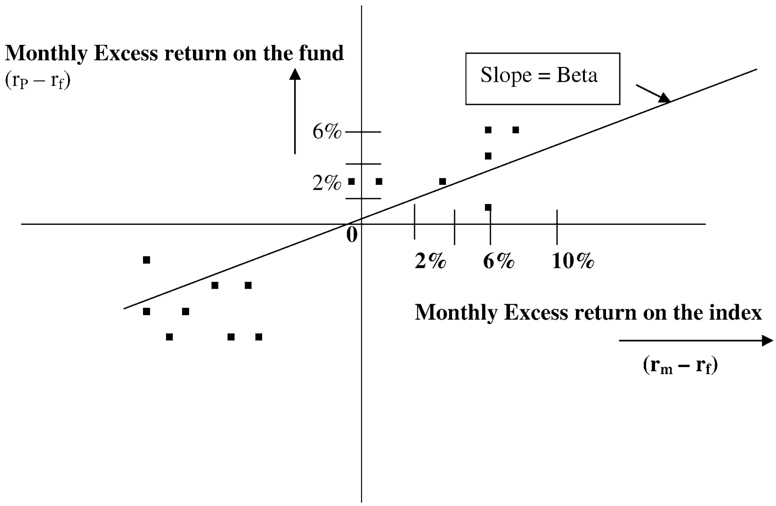
Risk free rate	= 5%	
S&P 500 index return	= 20%	
	Fund 1	Fund 2
Actual return (%)	17	14
Beta	0.8	0.6
Expected return	5% + 0.8(15%)	5% + 0.6(15%)
CAPM (%)	= 17	= 14
Alpha (%)	0	0

Although the first fund generated higher returns of its alpha, both the funds have the same alpha because of differences in risk (beta). Consequently, a rational investor would be indifferent between the two.

To estimate the expected return from a fund we need an estimate of beta. A portfolio's beta can be estimated by regressing the historical returns of the fund (in excess of risk-free rate) on the returns of the market (in excess of risk-free rate of return) over some time period (say 3 years) as shown in Exhibit 25.4.

The regression output provides statistics like alpha (the value of intercept), beta (slope), R^2 (goodness of fit, i.e., portion of total risk that can be attributed to systematic risk), standard deviation of fund returns, and standard deviation of unexplained returns. The standard deviation of unexplained returns is the fund's variation that is not explained by the regression. If the standard deviation of unexplained returns is high, it must be construed that the benchmark return (estimated using CAPM) is less meaningful.

Exhibit 25.4 Estimation of fund beta



Further, many funds often invest in more than one asset class (equity, bond etc.) because of which it is necessary to construct a model that incorporates the risk of other asset classes as well, not just equity. In other words, one has to construct a multifactor model as the one shown below:

$$E(R) = R_{\mathrm{f}} + \beta_1 [R_1 - R_{\mathrm{f}}] + \ldots + \beta_n [R_n - R_{\mathrm{f}}]$$

where R_{i} are returns from each asset class and β_{i} are their respective betas.

25.5 The Morningstar Rating System

As billions of dollars flow into mutual funds and thousands of funds are set up, the demand for professional fund performance measurement services has also gone up. Specialized agencies and credit rating companies provide a rating of performance of mutual funds all over the world. Two companies Morningstar, Inc. and Lipper Analytical Services provide mutual fund rating in the USA that investors can use in their decision-making process. Just as any other rating, the mutual fund star rating is not meant to predict future performance. The risk-adjusted return ranking is a purely quantitative measure of scheme performance put out by the agency periodically which ranks schemes on the basis of their risk-adjusted returns. It ranks schemes across many categories (e.g., general equity funds) based on their risk return equation. Fund manager and investors wanting to make a quick estimate of the periodic (say, monthly) relative performance of various schemes can use this as a reliable barometer.

The principal difference between the measures discussed earlier and the Morningstar approach is that the former are absolute or cardinal whereas the latter is ordinal or relative. That is, the performance of a fund is measured as a relative position within the group.

To arrive at a star rating, Morningstar divides all mutual funds into four asset classes: domestic stock funds, international stock funds, bond funds, and municipal bond funds. Morningstar follows four steps to calculate the star rating[12]:

25.5.1 Excess Return Measure

Morningstar calculates excess return for each fund by adjusting for sales load (all expenses related to investing in the fund) and subtracting the 90-day treasury bill

[12] Prof William Sharpe's website has an excellent collection of research on Morningstar approach. See http://www.stanford.edu/~wfsharpe/art/stars/stars0.htm. Morningstar's website contains the details of the "new" star rating methodology they follow now. See http://www.morningstar.com/

rate for that month each month. These excess returns are divided by the average excess return for the fund's asset class. That is,

$$\text{Excess return} = \frac{\text{Load adjusted fund excess return}}{\text{Average excess return for each asset class}}$$

25.5.2 Risk Measure

Morningstar calculates a measure of downside by counting the number of months in which the fund's excess return was negative, adding up all the negative returns and dividing by the total number of months in the measurement period.

The same exercise is repeated for the asset class as a whole. Morningstar defines risk as:

$$\frac{\text{Fund's average underperformance}}{\text{Average underperformance of the asset class}}$$

In the third step, the fund's risk score is subtracted from the return score to calculate its raw rating.

In the fourth step, all funds in an asset class are ranked by their raw rating and stars are assigned as follows:

Top 10%	5 stars
Next 22.5%	4 stars
Middle 355	3 stars
Next 22.5%	2 stars
Bottom 10%	1 star

Stars are calculated for 3, 5, and 10 years and then combined into an overall rating.

Apart from the star rating, Morningstar also calculates (more narrowly defined) category ratings under each asset class.

The following are some of the categories in domestic equity:

- Large value
- Large blend
- Large growth
- Small value
- Small growth

Likewise, the following are some of the categories under international equity:

- Europe
- Latin America
- Diversified Emerging Markets
- Pacific

25.6 Concluding Comments

Since there is more than one way to measure performance which measure should one use? One could use the Jensen's measure to decide on fund manager's compensation. One can use Sharpe ratio to decide on optimal portfolio choice if portfolio represents entire investment. The Treynor measure can be used for a fund that is just one subportfolio of a large set of passively managed portfolios.

The risk-adjusted measures have come under criticism for the following reasons:

- They use a market proxy (index) instead of the true market portfolio.
- They are unable to statistically distinguish luck from skill.
- They use an inappropriate risk free rate.
- They rely on the validity of CAPM.

Further, it is not enough if the Sharpe ratios of two funds are different, it must be economically significant.

Measures of a fund's performance can be found in:

- The mutual fund profiles and mutual fund screener available through an investments brokerage account
- The fund's Web site
- The fund's annual and semiannual shareholder reports
- Financial Web sites

The annual and semiannual reports also generally provide a list of fund holdings and an explanation from the fund's manager about recent economic and market factors that may have affected the fund's performance.

The star rating, style box, and such other information for fidelity contrafund is provided in Appendix.

Appendix: Star Rating and Other Information for Fidelity Contrafund in March 2007

Morningstar rating (relative to category)

Morningstar category **Large growth**

Morningstar return	Morningstar risk	Rating	
3 years	High	Average	5 stars
5 years	High	Low	5 stars
10 years	High	Low	5 stars
Overall	High	Low	5 stars

Source: Morningstar

Portfolio composition

Market capitalization	Portfolio (%)
Giant	51.78
Large	30.26
Medium	14.98
Small	2.73
Micro	0.24

This fund falls in the middle of the growth area of the style box. Growth stocks can have considerable upside potential, but they often trade at high prices. If they don't deliver the rapid growth expected of them, they can fall sharply. These stocks can be quite volatile. This fund's market cap is within the normal range for a fund with a large growth style.

Trailing returns

	Total return (%)	± S&P 500 TR	Ranking in category (%)
1 day	−1.30	0.06	72
1 week	0.47	0.65	23
1 month	0.98	1.49	26
3 months	8.37	0.69	32
1 year	22.28	−2.02	34
3 years (annualized)	16.01	3.91	4
5 years	13.28	2.79	5
10 years	11.27	3.49	4

Source: Morningstar

Volatility measurements **Trailing 3 years 05-31-07**

Standard deviation	9.18
Mean	16.63
Sharpe ratio	1.28
MPT statistics	
Beta (against S&P 500)	1.10
Alpha	2.07

Source: Morningstar

25.7 End of the Chapter Questions

1. Explain the terms total return and alpha in the context of securities.
2. What are the two measures of risk in the context of investments in securities?
3. Define VaR.

4. Describe the three approaches for measuring VaR.
5. Define Sharpe ratio, Treynor measure, and Jensen's alpha.
6. Describe Modigliani and Modigliani measure of performance.
7. Describe the Morningstar mutual fund rating methodology.

References

Blake CR, Morey MR (2000) Morningstar ratings and mutual fund performance. J Financial Quant Anal 35(3)
Carhart MM (1997) On persistence in mutual fund performance. J Finance, 52(1), 57–82
Jensen MC (1967) The performance of mutual funds in the period 1945–1964. J Finance, 23(2) 389–416
Kothari SP, Warner J (2001) Evaluating mutual fund performance. J Finance 56
Modigliani F, Modigliani L (1997) Risk adjusted performance. J Portfolio Manage Winter
Simons K (1998) Risk-adjusted performance of mutual funds. New Engl Econ Rev September–October
Sharpe WF (1966) Mutual fund performance. J Business (Supplement on Security prices) 39
Sharpe WF (1994) The Sharpe ratio. J Portfolio Manage Fall
Treynor JL (1965) How to rate management of investment funds. Harvard Business Rev 43
www-sharpe.stanford.edu

Chapter 26
Hedge Funds

S.R. Vishwanath and Chandrasekhar Krishnamurti

26.1 Chapter Introduction and Objectives

Hedge funds have grown to be an important segment of the world's financial markets. What started as a cottage industry has grown into a $4 trillion business. Hedge funds now control more than half the shares traded on a daily basis. This chapter provides an overview of hedge funds.

This chapter has the following objectives:

- Define hedge funds
- Distinguish between hedge funds and mutual funds
- Outline strategies followed by hedge funds

All these countries have spent 40 years trying to build up their economies and a moron like Soros comes along with a lot of money to speculate and ruin things.
– Mahathir Mohammad, Prime Minister of Malaysia, 1998
(from "*The Color of Hot Money*")

26.2 Introduction

A hedge fund is an aggressively managed portfolio of investments that uses advanced investment strategies such as leverage, long, short, and derivative positions in both domestic and international markets with the goal of generating high returns (either in an absolute sense or over a specified market benchmark). Hedge funds may be characterized as private investment programs where the manager seeks positive returns by exploiting investment opportunities, while protecting principal from

S.R. Vishwanath (✉)
Emirates Institute for Banking and Financial Studies, P.O. Box 4166, Sharjah, UAE
e-mail: srvishy@gmail.com

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_26,

financial loss. Hedge funds are quite diverse, as several strategies and techniques can be employed to attain the same investment objectives. Consequently, hedge funds are synonymous with the term "alternative investment strategies." Some hedge funds follow very conservative strategies while others are more aggressive.

Legally, hedge funds are most often set up as private investment partnerships that are open to a limited number of investors and require a very large initial minimum investment. Investments in hedge funds are illiquid as they often require investors keep their money in the fund for at least 1 year.

For the most part, hedge funds (unlike mutual funds) are unregulated because they cater to sophisticated investors. In the United States, laws require that the majority of investors in the fund be accredited. That is, they must earn a minimum amount of money annually and have a net worth of more than $1 million, along with a significant amount of investment knowledge. You can think of hedge funds as mutual funds for the rich. They are similar to mutual funds in that investments are pooled and professionally managed, but differ in that the fund has far more flexibility in its investment strategies.

The term "hedge funds" is often times a misnomer as some funds may not hedge their underlying positions. It is important to note that hedging is actually the practice of attempting to reduce risk, but the goal of most hedge funds is to maximize return on investment. The name is mostly historical, as the first hedge funds tried to hedge against the downside risk of a bear market by shorting the market (mutual funds generally can't enter into short positions as one of their primary goals). Nowadays, hedge funds use dozens of different strategies, so it isn't accurate to say that hedge funds just "hedge risk." In fact, because hedge fund managers make speculative investments, these funds can carry more risk than the overall market.[1]

26.3 The Hedge Fund Industry

The hedge fund industry, once a cottage industry that was the domain of ultra high net worth individuals and managed by a few hundred bright investment managers, has undergone major changes over the past decade. Due to continued outperformance, particularly during times of market downturns, the industry has undergone exponential growth, not only in terms of the number of hedge funds available but also in the types of investment strategies available, and the number and type of hedge fund investors. Today, the industry is over a 4 trillion dollar industry managed by thousands of hedge fund managers, many of whom are among the brightest minds in the financial industry.

They have grown from as few as 300 funds in 1990 to more than 12,000 today. However, despite the exponential growth of the industry, the hedge fund industry remains fragmented. Hedge funds operate within and are sold in a number of different countries, each with their own complex set of rules and regulation.

[1] However, we will show later many hedge funds are indeed less volatile than broad market proxies.

According to a new survey by Carbon360 Research, hedge funds are heading for $4 trillion despite a slowdown in asset growth. The industry managed about $3.8 trillion in assets as of March 31, 2008. Funds of funds – including private equity strategies – managed $1.32 trillion. But asset growth was expected to slow to 8–9% in 2008, bringing total assets in the industry to about $4 trillion by the end of the year. Hedge funds have grown by an annualized 28.5% over the last three calendar years, according to Carbon360's figures.

Carbon360's estimate of hedge fund size is significantly larger than most. The firm bases its numbers on a survey of 103 hedge fund administrators, as well as $438 billion managed by self-administered funds.

The league tables of hedge funds and hedge fund managers are presented in Exhibits 26.1 and 26.2.

Exhibit 26.1 Top 10 hedge funds as of June 30, 2007

Fund name	3 year cumulative average return
RAB Special Situations	47.69
The Children's Investment fund	44.27
Highland CDO Opportunity	43.98
BTR Global Opportunity, Class D	43.42
SR Phoenicia	43.10
Atticus European	40.76
Gradient Europe Fund A	39.18
Polar Capital Paragon	38.00
Paulson Enhanced Partners	37.97
Firebird Global	37.18

Source: Barron's

Exhibit 26.2 Top Hedge fund managers

Angelo Gordon, John Angelo and Michael Gordon
AQR Capital Management, Clifford Asness
Appaloosa Management, David Tepper and Jack Walton
Atticus Capital, Timothy Barakett, David Slagger
Avenue Capital, Marc Lasry, Sonia Gardner
Bessent Capital, Scott Bessent
Blackstone (Kailix Advisors), J Tomlinson, Bruce Amlicke, Halbert Lindquist
Blue Ridge Capital, John Griffin
Blue Mountain, Andrew Feldstein, Stephen Siderow, Gery Sampere
BP Capital Management, T Boone Pickens
Bridgewater, Ray Dalio

Source: Richard Wilson Hedge Fund Blogspot

26.4 Hedge Funds Versus Mutual Funds

Hedge funds differ from the traditional investment vehicles like mutual funds in terms of the nature of strategies, return objectives, correlation of returns, co-investment opportunities, compensation structures, liquidity, and transparency.

The most notable difference between hedge fund managers and traditional active managers is their attitude to risk and return. Most hedge fund managers characterize risk in terms of the potential loss of invested capital (total risk), whereas traditional active managers measure risk as the deviation from a stated benchmark. Hedge fund managers generally try to deliver a positive return that is independent of the general market direction, that is, the manager's objective is an absolute return. Traditional active managers generally aim to deliver returns that exceed a stated benchmark, thus the manager's goal is a relative return. However, this relative return may turnout to be negative if the benchmark return is negative. In some sense, we can say that hedge fund returns are mostly based on the manager's skill, while traditional manager's returns are largely driven by the market returns of the underlying assets.

Conventional managers invest in assets in the quest for above-average capital appreciation. They look for fair markets to invest and liquidate. Hedge fund managers, on the contrary, nearly always look for market distortions with the objective of arbitraging away the anomaly. In the simplest strategy, a manager may buy an instrument that is believed to be undervalued and simultaneously sell a similar instrument that is believed to be overvalued. The manager liquidates the position when the relative values have realigned to a normal relationship.

Most of the mutual funds are restricted in their investment options. In contrast, hedge funds have more flexibility in where and how they can invest. For this purpose, they can use leverage, sell securities short, and invest across different asset classes. Due to the flexibility of leverage, hedge funds can potentially multiply their returns (and risk) on the arbitrage opportunities in the market. The downside of the flexibility in investment is that it can reduce the ability of investors to monitor the activities of hedge fund manager. Some managers trade in and out of positions so frequently that direct oversight may not only be difficult but may also turn out to be ineffective. It can be exceedingly difficult to monitor whether the manager is diverging from his/her stated strategy, inappropriately using derivatives or leverage or engaging in other unacceptable investment behavior that may potentially cause the fund to lose money or even go bankrupt.

Conventional asset managers tend to operate in an established fashion handling all the activities in-house. Hedge funds, in contrast, are started by entrepreneurs who have a specific expertise (e.g., arbitrage) and concentrate on it and outsource everything else.

Unlike mutual funds that are often regulated by the Securities Exchange Commission (SEC), hedge funds are largely exempted from disclosure and regulation as they cater to high net worth individuals and institutions through private placements. In addition, the minimum investment is usually much higher ranging from \$100,000 to \$20 million. However, this figure can reduce substantially, if one invests through fund of funds that invests in other hedge funds. More recently, the industry has been lowering the investment threshold to make hedge funds available to a wide range of investors.

In contrast to most mutual funds, hedge funds typically impose significant restrictions on the withdrawal of funds by their clients. They usually require a lock-up period of up to 12 months and more in some cases before withdrawals are permitted. This feature potentially provides the hedge funds with a flexibility of investing in relatively illiquid securities from the long-term point of view.

Given below are some stylized facts about hedge funds (**? ?**):

- Over the past 10 years, the typical individual hedge fund has produced risk adjusted returns that are quite similar to the typical mutual fund manager. However, individual hedge funds have realized a much wider range of performance compared with mutual funds.
- Indexes of hedge funds tend to display risk-adjusted performance superior to traditional active managers and passive benchmarks.
- Volatility of hedge fund indexes is typically much lower than that of mutual fund indexes and equity benchmarks. This is because of the low correlation among individual hedge funds.
- The performance of hedge fund indexes can be closely approximated with a portfolio of as few as 20 hedge funds, suggesting a pooled fund-of-funds approach as a viable alternative investment strategy.

The following are the distinguishing characteristics of hedge funds as compared to traditional investment funds:

- Absolute return goals: Hedge fund managers endeavor to achieve positive returns in all market conditions, since their primary goal is to protect investors' capital.
- Flexible investment strategies: Hedge fund managers can use an extensive range of investment strategies and tools, such as derivatives and leverage, to exploit opportunities, as well as to minimize a particular risk related to an opportunity.
- Investment structure: Hedge funds can be organized in a variety of ways including limited partnerships, limited liability companies, unit trusts, or listed entities. Several hedge funds are domiciled in offshore jurisdictions such as the Cayman Islands, Ireland, Bermuda, etc.
- Performance fees: Performance fees are a principal feature of hedge funds. Funds usually have a high-water mark to ensure that the manager only earns performance fees on returns generated by positive returns above a certain level.
- Alignment of managers' interests with investors' interests: In general, a large proportion of hedge fund managers' personal assets is invested in their own funds, which aligns their interests with those of their investors.
- Limited liquidity and lock-up periods: Hedge funds normally sell or redeem units monthly, but certain funds/strategies may entail lock-up periods where investors cannot cash in their investment. Lock-up periods for hedge funds usually range from 3 months to 1 year, but could be longer. Furthermore, some quarterly redemption policies may necessitate a long notice period (e.g., 60 days). Alternatively, there may be early redemption penalties.

- Low correlations with traditional asset classes: Several hedge fund strategies have low or even negative correlations with traditional asset classes, such as stocks and bonds. Many hedge fund strategies also have low correlations with each other. Consequently, hedge funds can provide valuable diversification benefits.
- Leverage: Varying amounts and types of leverage are used in a majority of hedge fund strategies. Several relative value strategies (non-directional) tend to use higher leverage than directional strategies.
- Capacity constraints: Despite the fact that hedge funds can stay open to new investment for many years, some hedge funds may close to new investors, in order to limit their size to protect investment returns.
- Transparency: Many Fund of Funds (FOFs) managers do not reveal the names and/or the positions of their underlying hedge funds to investors. Likewise, several single-strategy hedge fund managers do not divulge their holdings to fund investors.
- Investment minimums: Since hedge funds are sold primarily in the exempt market (i.e., without a prospectus), there are high minimum investments.
- Income distributions and taxes: The income distributions from hedge funds may vary depending on the hedge fund structure (i.e., whether it is a limited partnership or a trust). Investors must recognize the tax implications of any distributions, and consult a tax professional before committing funds to hedge funds.

26.5 Two Views on Hedge Funds

Opponents of hedge funds believe that they are inherently bad for long term investors because they exacerbate market volatility and inefficiencies through taking speculative short positions for short-term gains. But this view is flawed because, by definition, arbitrage strategies help bring distorted markets back into equilibrium.

Proponents of hedge funds assert that they represent a new asset class, with the added benefit of being highly uncorrelated. This makes hedge funds attractive candidates for portfolio diversification.

Further, any arbitrage strategy opportunity would show diminishing returns as it matures and grows relative to the underlying assets being arbitraged. Hedge funds may control \$ 3–4 trillion of assets whereas the value of worldwide financial assets is \$ 50 trillion, suggesting that hedge funds have room to grow. But the opportunities are not unlimited.

26.6 A Brief History of Hedge Funds

The first hedge fund was created by Albert Wislow Jones in 1949. The primary strategies used by him were the long–short equity positions and leverage. The fund charged an incentive fee based on performance. Hedge funds were little known to

Exhibit 26.3 Number and assets of Hedge funds and CTA funds

	1985	1990	1991	1992	1993	1994	1995	1996	1997
Numbers									
Hedge Funds	37	231	310	442	644	856	1027	1076	987
CTA Funds	114	404	468	557	577	558	488	363	291
Assets under management									
Hedge Funds	0.4	6.5	10.1	17.9	35.8	41.3	50.4	59.4	64.6
CTA Funds	5.9	34.3	36.6	41.3	49.9	41.8	22.6	12.8	17.1

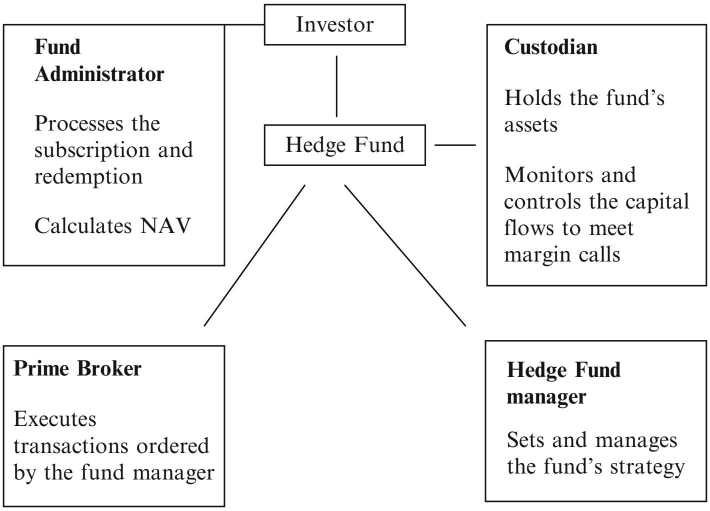
the investment world until 1966, when an article in *Fortune* described Jones' funds to achieve returns (net of fee) significantly higher than the best performing mutual funds. This led to a cascade of new hedge funds during the subsequent 2 years. In the ensuing years, the hedge fund industry waned. During the bear markets of 1969–1970 and 1973–1974, many funds suffered losses and capital withdrawals. Hedge funds remained in obscurity until 1986, when an article in *Institutional Investor* reported that Julian Robertson's Tiger Fund had produced compounded annual returns of 43% during its first 6 years of existence, after accounting for expenses and incentive fee. This resulted in a fresh burst of interest in hedge funds. Hedge funds (and commodity trading advisor [CTA] funds) experienced a remarkable growth in the subsequent decade as shown in Exhibit 26.3.

26.6.1 Structure

Hedge funds are generally organized as limited partnerships, in which the investors are limited partners and the managers are general partners. As general partners, the fund managers generally invest a considerable portion of their personal wealth into the partnership. This ensures the alignment of economic interests among the partners. Investors in the partnership are charged a performance-based fee where the potential payout to successful managers can significantly exceed the fixed management fee. This organization structure has survived for more than 50 years.

Another group of funds that is often considered part of the same investment category as hedge funds are commodity trading pools. These investment pools are often structured similar to hedge fund partnerships but are usually operated by CTAs. CTAs may be individuals or firms who manage customer funds or offer advice for trading futures contracts or options on futures contracts. It is mandatory for CTAs to register with the Commodity Futures Trading Commission (CFTC) through the National Futures Association (NFA), a self-regulatory body for the futures industry. Traditionally, CTA funds are differentiated from hedge funds based on their trading activity which is limited to mainly futures contracts. However, the rapid expansion of financial derivatives, the globalization of markets, and the reduction in regulatory constraints have given CTAs the capability to take exposure in additional financial instruments such as interest rates, currencies, and stock indices. These days, CTAs

Exhibit 26.4 Structure of hedge fund offering



frequently trade in the over-the-counter securities market especially in derivative instruments. As a result, the distinction between hedge funds and CTA funds has become blurred.

A US hedge fund is usually a US Private investment partnership invested primarily in publicly traded securities and derivatives. As these funds are private investment partnerships, the SEC limits US hedge funds to 99 investors, at least 65 of those must be accredited. An accredited investor is one who has made $ 200,000 in income for the past 2 years and has a reasonable expectation of doing so in future; one who, together with spouse has an annual income of $ 300,000 per year; or one who has a net worth of $1 million, excluding home and automobile. Generally, this would include corporations, partnerships, limited liability companies, and other entities with total assets in excess of $ 5 million.

Usually, the investment manager is the general partner who also invests capital into the partnership. The general partner of the fund usually receives 20% of the profits, in addition to a fixed management fee, usually one percent of the assets under management (AUM).

A typical structure of a hedge fund offering is shown in Exhibit 26.4.

26.6.2 Regulation

Hedge funds are unregistered, private investment pools bound by the investment agreement that investors sign with the sponsors of the hedge fund. Hedge funds must satisfy certain disclosure obligations in the offering of securities. Hedge funds are subject to the SEC's anti-fraud and anti-manipulation provisions and, depending on an individual fund's exposure to commodities, the managers are required to register the fund with the commodities and futures trading commission. Hedge fund managers can avoid SEC scrutiny by not registering as investment advisors. The sponsors of the hedge fund do not have any limitations in the management of the fund under the federal law. There are no limits on the composition of their portfolios, and no mandatory disclosure of information about the holdings and performance.

In the US, three sets of regulators supervise the financial industries. The SEC oversees publicly traded securities, including the corporations that issue them, and the broker-dealers that make markets in them. The CFTC oversees the futures industry. The Federal Reserve, the Office of the Comptroller of the Currency, and the Office of Thrift Supervision oversee the commercial banking and thrift industry. These agencies were created on the premise that government should regulate institutions that deal with the general public. Hedge funds do not deal with public investors. They are private investment vehicles for affluent investors and most institutional investors who are considered as "sophisticated" and are treated differently from the general investing public. As a result, hedge funds fall outside the direct jurisdiction of these regulators.

SEC's authority stems from various securities laws. The Securities Act of 1933 requires firms issuing publicly traded securities to register with the SEC and file disclosure reports, to guarantee that these firms provide the general public with all relevant information. Under the safe harbor provision of Rule 506 in Regulation D, a hedge fund may claim the status of a private placement, and hence be exempted from most registration and disclosure requirements. In order to qualify for this exemption, a hedge fund can have no more than 35 "nonaccredited" investors and are prohibited from solicitation. The SEC's definition of "accredited" investor is an individual who has more than US$1 million in financial wealth or earns more than US$200,000 in the previous 2 years. The SEC's definition of non-solicitation is in essence word-of-mouth communication. The Securities Exchange Act of 1934 empowers the SEC power to regulate securities brokerage firms that face potential conflicts of interest in executing customer orders as well as trading on their own accounts. Broker-dealers are therefore required to keep detailed records of their own trades as well as those of their customers. Hedge funds are by and large exempt from registration as a broker-dealer and the associated costly reporting requirements as long as they trade only for their own investment accounts.

The Investment Advisers Act of 1940 extends the powers of the SEC to regulate investment advisors. This Act calls for mandatory registration of all persons or firms compensated for advising clients regarding securities investments. Furthermore, they must conform to statutory standards designed to protect investors. A hedge manager typically escapes registration by having less than 15 clients and by not soliciting business from the general public. The Investment Company Act of 1940 establishes the authority of the SEC to regulate the mutual fund industry. This Act severely limits a mutual fund's ability to leverage or borrow against the value of securities in its portfolio. A hedge fund is not an investment company if it has no more than 99 investors and by not making any public offerings is exempt from the registration, disclosure requirements, and leverage restrictions pertaining to investment companies. Recently, legislation has increased the exemption to 499 investors, provided each investor has more than US$5 million in assets.

Furthermore, hedge fund managers are allowed to collect certain types of performance-based fees that are proscribed to mutual funds. Mutual fund performance-based fee must comply with the "fulcrum" rule. That is, gains and losses must have a symmetric effect, in the sense that the same amount of over- and under-performance relative to a benchmark must result in the same amount of positive and negative incentive fees for a mutual fund manager. Hedge fund managers are not subject to the "fulcrum" rule, or for that matter, any rules other than what the private investors would bear. In general, hedge fund managers get asymmetric fees in that they receive positive incentive fees for gains but are not required to refund fees to investors for losses. This embedded "put option" is one of the hotly contested issues on hedge fund managers' compensation.

Created by the Commodity Exchange Act of 1974 to regulate the futures markets in the United States, the CFTC's mandate is to protect market participants against manipulation, abusive trade practices and fraud. Any person or body that handles customer funds or provides trading advice in futures contracts must register with the NFA, a futures industry self-regulatory body approved by the CFTC. In addition, these registrants must "disclose market risks and past performance information to prospective customers." If a hedge fund trades futures and options on futures on behalf of its investors, it may be required to file as a CPO with the CFTC. However, a hedge fund may qualify for exemption from certain requirements in registration, disclosure, and record maintenance. Lastly, the bank regulators such as the Federal Reserve, Comptroller of the Currency, and Office of Thrift Supervision do not have direct power over hedge funds, since hedge funds are not banks.

While hedge funds are exempt from most regulations, they are still required with a few regulations that are designed to monitor and safeguard the integrity of markets. The US Treasury requires traders to report large positions in selected foreign currencies and treasury securities. In addition, the SEC requires traders to report positions that exceed 5% of the shares of a publicly traded firm. The Federal Reserve has margin requirements for stock purchases that apply to all market participants. Traders with large futures positions are required to file daily reports with the CFTC. In addition, the CFTC and the futures exchanges impose futures margins and position limits on futures contracts. These regulations are applicable to all market participants, including hedge funds.

26.6.3 Fees

As mutual funds (and closed-end funds) may offer their securities to the greater investing public, their managers are severely restricted in their rewards, as the fees for investment advisers are limited to a percentage of AUM. Rewards based on the fund's actual performance for its investors are prohibited. On the contrary, the mutual fund manager is still entitled to his fee, even if the fund's performance has been subpar.

By contrast, hedge funds are different. The nature and tax implications of the rewards received by a hedge fund manager are intertwined with the fund's domicile and organizational structure. An investment adviser to a domestic hedge fund generally receives compensation composed of an investment management fee and an incentive (performance-based) reallocation of profits. The investment management fee is an asset-based fee, similar to the advisory fee charged to registered investment companies and is designed to provide the investment manager with current cash flow to maintain operations. The investment management fee is generally 1–2% of AUM. Although the typical fund offering provides for a management fee paid to the manager periodically (e.g., monthly or quarterly, usually in advance but sometimes in arrears), it is the rare hedge fund manager who can survive even on a fee of 2% of AUM. Rather, it is in the "performance reallocation of profits" (for domestic funds with an entrepreneurial manager that is fiscally transparent) or "performance fee" (for a corporate adviser or an offshore fund) that financial rewards are realized.

Fung and Hsieh (1999) determine that the median management fee is between 1% and 2% of AUM and the median incentive fee is 15–20% of profits. Ackermann et al. (1999) cite similar median figures: a management fee of 1% of assets and an incentive fee of 20% (a so-called "1 and 20 fund"). The incentive fee is a crucial feature for the success of hedge funds. A pay-for-profits compensation causes the manager's aim to be absolute returns, not merely beating a benchmark. To achieve absolute returns regularly, the hedge fund manager must pursue investment strategies that generate returns regardless of market conditions; that is, strategies with low correlation to the market. However, a hedge fund incentive fee is *asymmetric*; it rewards positive absolute returns without a corresponding penalty for negative returns.

Empirical studies provide evidence for the effectiveness of incentive fees. Liang (1999) reports that a 1% increase in incentive fee is coupled with an average 1.3% increase in monthly return. Ackermann et al. (1999) determine that the presence of a 20% incentive fee results in an average 66% increase in the Sharpe ratio, as opposed to having no incentive fee. The performance fee enables a hedge fund manager to earn the same money as running a mutual fund 10 times larger (Tremont Advisers and TASS Investment Research 2002). There is the possibility that managers will be tempted to take excessive risk, in pursuit of (asymmetric) incentive fees. This is one reason why, in many jurisdictions, asymmetric incentive fees are not permitted for consumer-regulated investment products.

The distribution of management and incentive fees for hedge funds and CTA funds are shown in Exhibit 26.5.

26.6.4 Strategies

Hedge funds employ many different trading strategies, which are classified in many different ways. They can be classified on the basis of their style; the market in which they operate; the instruments they invest in; the nature of exposure; the sectors in which they invest; the method of asset allocation; and diversification as follows.

- Style: global macro, directional, relative value (arbitrage) event driven, managed futures (CTA)
- Market: equity, fixed income, commodity, and currency

Exhibit 26.5 Distribution of management and incentive fees

	Hedge funds %	CTA funds %
Management fees %		
NA	4	13
0–1	38	4
1–2	40	53
2–3	10	16
3–4	6	12
4–5	0	0
5–8	2	1
Incentive fees %		
NA	17	1
0–5	1	0
10–15	14	10
15–20	51	69
20–25	10	16
25–30	1	3
30–35	0	0
35–55	0	0

Source: TASS

- Instrument: long/short, futures, and options
- Exposure: directional, and market neutral
- Sector: emerging market, technology, healthcare, etc.
- Method: discretionary/qualitative (where the individual investments are selected by managers), and systematic/quantitative (or "quant" – where the investments are selected according to numerical methods using a computerized system)
- Diversification: multimanager, multistrategy, multifund, and multimarket.

The term global macro is used to classify the strategy of certain hedge funds – those that take positions in financial derivatives, on the basis of forecasts and analysis about interest rate trends, movements in the general flow of funds, political changes, government policies, intergovernment relations, and other broad systemic factors.

Relative value is the attractiveness measured in terms of risk, liquidity, and return of one instrument relative to another, or for a given instrument, of one maturity relative to another. Some hedge funds engage principally in arbitrage strategies in the global equity and corporate debt securities markets taking advantage of mispricings between two related and correlated securities. Typical arbitrage strategies include fixed income arbitrage, convertible bond arbitrage, mortgaged-backed arbitrage and derivative arbitrage.

Event-driven strategies try to exploit pricing inefficiencies caused by anticipated specific corporate events like mergers. In a cash merger, an acquirer proposes to purchase the shares of the target for a certain price in cash. Until the acquisition is completed, the stock of the target typically trades below the purchase price. An arbitrageur buys the stock of the target and makes a gain if the acquirer ultimately buys the stock. In a stock-for-stock merger, the acquirer proposes to buy the target by exchanging its own stock for the stock of the target. An arbitrageur may then short sell the acquirer and buy the stock of the target. This process is called "setting a spread." After the merger is completed, the target's stock will be converted into stock of the acquirer based on the exchange ratio determined by the merger agreement. The arbitrageur delivers the converted stock into his short position to complete the arbitrage.

Long/short equity refers to long equity position hedged with short sales of stocks or stock index options.

An investment strategy is considered market neutral if it seeks to entirely avoid some form of market risk, typically by hedging. In order to evaluate market neutrality, it is first necessary to specify the risk being avoided. For example, convertible arbitrage attempts to fully hedge fluctuations in the price of the underlying common stock.

A portfolio is truly market neutral if it exhibits zero correlation with the unwanted source of risk. Market neutrality is an ideal which is seldom possible in practice. A portfolio which appears to be market neutral may exhibit unexpected correlations as market conditions change. The risk of this occurring is called basis risk.

26.7 Hedge Fund Indexes

In line with the growth of the industry, the number of hedge fund indexes is also growing. There are about 21 indexes (see Exhibit 26.6). The FTSE Hedge Index aims to provide both a daily indicative measure and monthly official performance of the universe of open, investable hedge funds, appropriately diversified by trading strategy and management style.

The FTSE hedge index is composed of the following three indices representing specific Management Styles:

- FTSE Hedge Directional Index
- FTSE Hedge Non-Directional Index
- FTSE Hedge Event Driven Index

These three management style indices in turn contain various trading strategy indices. The FTSE Hedge Index comprises the following indices:

Management style indices	Trading strategy indices
FTSE hedge directional index	Equity hedge
	CTA/managed futures
	Global macro
FTSE hedge nondirectional index	Equity arbitrage
	Fixed income arbitrage
	Convertible arbitrage
FTSE hedge event driven index	Merger arbitrage
	Distressed and opportunities

Exhibit 26.6 Hedge fund indexes

Alternative Asset Center (FoHFs)
Barclay (Global Hedge fund source)
Blue Chip Hedge Fund index
CISDM
CSFB/Tremont
Dow Jones
EDHEC alternative indices
Eureka Hedge indices
Evaluation Association Capital markets
Feri alternative assets
FTSE Hedge
Hedge Fund Net (Tuna indexes)
Hedge Fund Intelligence
Hedge Fund News (Bernheim)
Hedge Fund Research
Hennessee Group
MondoHedge (Italy)
MSCI Hedge Fund Indices
Standard & Poor's
Talent Hedge
Van Hedge Fund Indexes

Exhibit 26.7 Daily performance of Dow Jones Hedge Fund Indexes as of August 12, 2008 (in %)

Strategy	Index level	One day change	MTD change	QTD change	YTD change
Convertible arbitrage	123.65	0	−0.69	−2.51	−8.35
Distressed securities	163.38	−0.01	−0.63	−1.93	−7.39
Equity long/short	132.6	0.16	−1.6	−5.7	−3.3
Equity market neutral	107.25	−0.36	−3.74	−4.37	−2.95
Event driven	146.86	−0.12	0.23	−1.95	−1.92
Merger arbitrage	145.2	−0.05	0.27	0.32	0.76

The base currency for the FTSE Hedge Index is US dollars. The FTSE Hedge Index is also produced in GBP, Euro, Yen, and CHF by use of 1 month forward rates. The Dow Jones Hedge Fund Strategy Benchmarks are intended to be style-pure hedge fund strategy indexes based on the performance of a managed account platform structured to meet the needs of institutional investors. Exhibits 26.7 and 26.8 present the performance of the Dow Jones Hedge Fund Indexes.

Exhibit 26.8 Monthly daily performance of Dow Jones Hedge Fund indexes as of August 12, 2008 (in %)

Strategy	1 M	3 M	12 M	2007	2006	2005	2004	2003	2002	Cumulative	Annualized
Convertible arbitrage	0.03	−1.3	−5.78	2.63	10.77	−5.61	1.52	11.81	10.76	26.83	3.72
Distressed securities	−1.8	−0.1	−11.4	0.15	15.59	6.73	15.46	23.07	0.48	66.6	8.17
Equity long/short	0.53	9.33	10.38	19.79	8.3	3	N/A	N/A	N/A	40.62	9.74
Equity market neutral	1.88	2.01	0.58	1.54	7.12	1.72	0.79	N/A	N/A	12.15	2.32
Event driven	−2.8	1.81	−1.12	5.67	12.65	6.52	10.36	17.92	−9.26	49.78	6.41
Merger arbitrage	−1	1.08	5.49	16.12	9.28	2.87	3.67	7.63	−1.07	44.74	5.85

Source: Dow Jones

26.8 Risks in Hedge Funds

Investing in certain types of hedge fund can be a riskier proposition than investing in a regulated fund. The following are some of the primary reasons for the increased risk in hedge funds:

26.8.1 Leverage

In addition to money invested into the fund by investors, a hedge fund will typically borrow money, with certain funds borrowing sums many times greater than the initial investment. If a hedge fund has borrowed \$9 for every \$1 received from investors, a loss of only 10% of the value of the investments of the hedge fund will wipe out 100% of the value of the investor's stake in the fund, once the creditors have called in their loans. In September 1998, shortly before its collapse, Long Term Capital Management had \$125 billion of assets on a base of \$4 billion of investors' money, a leverage of over 30 times. It also had off-balance sheet positions with a notional value of ~\$1 trillion (Jorion 2000).[2]

26.8.2 Short Selling

Due to the nature of short selling, the losses that can be incurred on a losing bet are theoretically limitless, unless the short position directly hedges a corresponding long position. Therefore, where a hedge fund uses short selling as an investment strategy rather than as a hedging strategy it can suffer very high losses if the market turns against it. Ordinary funds very rarely use short selling in this way.

26.8.3 Appetite for Risk

Hedge funds are culturally more likely than other types of funds to take on underlying investments that carry high degrees of risk, such as high yield bonds, distressed securities and collateralized debt obligations.

26.8.4 Lack of Regulation

Hedge funds are not subject to as much oversight from financial regulators as regulated funds, and therefore some may carry undisclosed structural risks. Investors in

[2] Philippe Jorion's article on the debacle of LTCM is an excellent account of risk management issues in hedge funds.

hedge funds are, in most countries, required to be sophisticated investors who will be aware of the risk implications of these factors. They are willing to take these risks because of the corresponding rewards: leverage amplifies profits as well as losses; short selling opens up new investment opportunities; riskier investments typically provide higher returns; secrecy helps to prevent imitation by competitors; and being unregulated reduces costs and allows the investment manager more freedom to make decisions on a purely commercial basis.

26.8.5 Lack of Transparency

Hedge funds are secretive entities with few public disclosure requirements. It can therefore be difficult for an investor to assess trading strategies, diversification of the portfolio and other factors relevant to an investment decision.

26.9 Hedge Fund Risk and Return

Since hedge funds account for more than half of all daily trades and are an important part of the asset mix of individuals and institutions, the risk and return of investing in them has attracted a lot of attention. Exhibit 26.9 reports the annual returns and standard deviation of various hedge fund categories and compares them with the returns and standard deviation of S&P 500 and US T Bill for the period 1995–2003.

Exhibit 26.9 Risk and return of Hedge funds 1995–2003 (in %)

Fund type	Return	Standard deviation
Convertible arbitrage	11.42	15.56
Dedicated short bias	−0.01	23.82
Emerging markets	14.19	44.09
Equity market neutral	5.56	13.08
Event driven	9.71	17.73
Fixed income arbitrage	7.04	17.7
Fund of funds	6.67	15.97
Global Macro	6.79	24.15
Long-short equity hedge	10.33	29.91
Managed futures	7.68	23.22
Other	11.42	29.71
Hedge Fund Universe	8.82	9.21
CSFB	13.41	10.36
S&P 500	12.38	21.69
US T Bill	4.2	1.78

Source: Malkiel and Saha (2005)

In general, hedge fund categories are less risky than a passive benchmark like S&P 500. A study by Morgan Stanley finds that the indexes of hedge funds exhibit considerably lower risk than traditional active managers and passive benchmarks. The annualized geometric return of all hedge funds was 18.9% from the beginning of 1990 through June of 2000, with volatility of 5.5% a year and a Sharpe Ratio of 2.5 (assuming a 5% annual hurdle rate), comparing favorably to the Lipper large cap managers and the S&P 500.

The low correlation between hedge fund managers lowers the volatility of the hedge fund indexes substantially below that of the Lipper managers and the S&P 500. Relative Value managers had the best risk-adjusted excess performance during this period (Sharpe Ratio of 3), while Directional Trading managers had the worst (Sharpe Ratio of 1.4). Performance varies considerably among sub-strategies, with, for example, a negative Sharpe Ratio for the Short Bias Stock Selection managers.

Hedge fund performance has varied through time, with lower figures in the most recent $5^1/_2$ years. Volatility also appears to have increased in more recent periods. Hedge funds produced higher absolute returns than traditional active man managers up to 1994, while the reverse has been true in the strong momentum markets since then. In general, however, the risk-adjusted performance of the universe of hedge funds appears to have been superior to traditional active managers and passive benchmarks over the last 10 years

26.10 Survey Results

During September and October of 2004, PricewaterhouseCoopers conducted its second hedge fund survey focused on valuation and risk management issues impacting hedge fund managers. PwC posed questions that covered broad risk-related topics, including governance, valuation, investment practices, and operational risk management practices. The survey questionnaire was designed to gather detailed information on specific policies, procedures, reporting, tools, and organizational structures used by leading hedge fund firms. The findings provide insights into current industry practices and innovations as well as data to enable participants to benchmark their own initiatives to improve controls and operational efficiency.

The results of the survey are given below:

- Enhanced risk management practices are clearly a priority for hedge fund managers. In particular, all firms surveyed indicated that they dedicate significant time and resources to valuation issues. However, despite increased expectations from regulators and investors, there are still large differences in the transparency and documentation of valuation policies and procedures, especially for non-listed and less liquid products.
- Survey participants also confirmed the importance of maintaining strong controls over valuation, reconciliations, and market risk. However, the data reveals a wide range in the size and organization of resources used to support these functions and to maintain segregation of duties.

- Similarly, the firms in the survey population are at different stages in developing their basic risk infrastructure consisting of compliance, internal audit, risk management, and IT/data management.
- The survey confirmed that the governance structures of hedge funds have not changed significantly despite the forces of change that have impacted public companies and registered investment companies.

Another survey by KPMG Financial Advisory Services Luxembourg on financial risk management for hedge funds has confirmed that hedge fund transparency remains one of the most significant challenges for the industry.

Participants included European hedge fund and fund of hedge fund managers with combined AUM of 38.5 billion and Luxembourg fund administrators with combined hedge fund and fund of hedge fund assets under administration of 23.7 billion.

The key findings of the survey are given below:

- 28% of participants shared the opinion that greater hedge fund transparency would have a material impact on investor confidence and 17% believed it would have a significant impact. Meanwhile, about 36% concluded that it would have a minimal impact on investor confidence. 19% stated that the impact of greater hedge fund transparency would depend on the hedge fund strategies.
- There was no consensus among participants about whether hedge fund risk management by an independent risk provider would significantly improve transparency. Although two-thirds of participants concurred that fund administrators should not be made responsible for providing risk management information, a majority supported the idea that the implementation by a fund administrator of a full-scale financial risk management capability would provide them with a significant competitive advantage.
- The listing of hedge funds or funds of hedge funds on a stock exchange is perceived to have an important favorable impact on the marketability of these instruments but a large majority concluded that the listing would not necessarily enhance transparency.

26.11 Concluding Comments

The size of the hedge fund industry, relative to the markets in which the funds operate, is too small for hedge funds alone to move the market. So the allegation against hedge funds that they drive markets in a wrong direction is not true. However, it is possible that they may move the market because other investors follow their lead – an effect referred to as "herding." But studies of the role of hedge funds in the Asian currency crises find little evidence that hedge funds were the market leader – or even the lead bull in the herd. Hedge funds managers and marketers are reluctant to entertain comparisons between the LTCM debacle and their own activities. Hedge funds are not wholly different from other businesses. LTCM was highly geared, but so are most banks and investment banks. And although some hedge funds do gear internally, only a fifth of them have debt-to-asset ratios above 50%, on a par with many industrial companies. Hedge funds can only play a limited role in the sense, they do not create conditions themselves, they only capitalize on the sometimes warped fundamentals of the markets.

26.12 End of the Chapter Questions

1. Define hedge funds.
2. Describe the legal structures of hedge funds.
3. Trace the history of hedge funds.
4. Describe the hedge fund investment strategies.
5. How is hedge fund risk measured?

References

Ackermann C, McEnally R, Ravenscraft D (1999) The performance of hedge funds: risk, return, and incentives. J Finance 54(3):833–874

Agarwal V, Naik NY (2000) On taking the alternative route: risks, rewards and performance persistence of hedge funds. J Altern Invest 2(4):6–23

Amin GS, Kat HM (2001) Hedge fund performance 1990–2000: do the ‘money machines’ really add value. Working Paper

Brown SJ, Goetzmann W, Ibbotson RG (1999) Offshore hedge funds: survival and performance. J Business 72:91–117

Brown SJ, Goetzmann W, Park JM (2001) Careers and survival: competition and risk in the hedge fund and CTA industry. J Finance 56(5):1869–1886

Crerend WJ (1998) Fundamentals of hedge fund investing: a professional investor’s guide. McGraw Hill, New York

de Brouwer G (2001) Hedge funds in emerging markets. Cambridge University Press, Cambridge, UK

Dowd K (1999) Too big to fail? long-term capital management and the federal reserve. CATO Institute Briefing Paper No. 52, September

Fung W, Hsieh DA (1999) Measuring the market impact of hedge funds. J Empirical Finance 6:309–331

Fung W, Hsieh DA (2000) A primer on hedge funds. J Empirical Finance 7:1–36

Fung W, Hsieh DA (2001) The risk in hedge fund strategies: theory and evidence from trend followers. Rev Financial Stud 14(2):275–302

Jorion P (2000) Risk management lessons from long-term capital management. Eur Financial Manage 6

KPMG (2003) Hedge fund financial risk management survey. Altern Invest Manage Assoc J

Lavinio S (2000) Hedge fund handbook: a definitive guide for analyzing and evaluating alternative investments. McGraw Hill, New York

Lederman J, Klein RA (1995) Hedge funds: investment and portfolio strategies for the institutional investor. Irwin, Burr Ridge, IL

Lhabitant F-S (2002) Hedge funds: myths and limits. Wiley, Chichester, UK

Liang B (1999) On the performance of hedge funds. Financial Anal J 55(4):72–85

Liang B (2001) Hedge fund performance 1990–1999. Financial Anal J 57(1):11–18

Malkiel B, Saha A (2005) Hedge funds: risk and return. Financial Anal J 61(6)
President's Working Group on Financial Markets (1999) Hedge funds, leverage and the lessons of long-term, capital management. Washington, DC
Price Waterhouse Coopers (2004) Global hedge fund valuation and risk management survey
Tremont Advisers and TASS Investment Research (2002) In: Darrell Jobman (ed) Hedge funds-the handbook of alternative investments. Wiley, New York

Chapter 27
Investing in Emerging Markets

S.R. Vishwanath

27.1 Chapter Introduction and Objectives

Emerging markets like India and China have attracted a lot of attention by international investors because of the exceptional returns provided by them in the recent years. The table given below presents data on stock market returns around the world during June–December 2007.

Index	Return (in %)
National Stock Index 50 index (Nifty, India)	43
Bombay Stock Exchange Sensitive Index	40
Shanghai Composite	30
Hang Seng (Hong Kong)	28
Kospi (South Korea)	10
Nasdaq (USA)	5
DAX (Germany)	1
Dow Jones (USA)	1
FTSE 100 (London)	−2
CAC 40 (Paris)	−6
Nikkei (Japan)	−13

As you can see, India has topped the world markets in returns. But is there a free lunch? Are investors better off on a risk-adjusted basis by investing in emerging markets? This chapter provides an overview of risks and return in investing in emerging markets. This chapter has the following objectives:

- Provide an overview of characteristics of emerging markets
- Provide a rationale for investing internationally

S.R. Vishwanath
Emirates Institute for Banking and Financial Studies, P.O. Box 4166, Sharjah, UAE
e-mail: e-mail: srvishy@gmail.com

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_27,

- Provide a framework for assessing the risk of investing in emerging markets
- Highlight the issues in valuing companies in emerging markets and provide an overview of methods

27.2 What Is an "Emerging" Market?

The International Finance Corporation of the World Bank, who coined the term in 1981, define an emerging market as any economy where the per capita gross national product is less than $9,385 a year. In this sense, it is just a polite or an aspirational term for any poor country, and covers around 80% of the global population, including the world's great economic powerhouse, China. However, for investors, an emerging market generally means a low-to-middle income nation which is pursuing substantial economic and political reforms and thus becoming more integrated into the global economy.

An emerging market might have an underdeveloped or developing commercial and financial infrastructure and a recent history of rescheduling or even defaulting on sovereign debt. But it should also have a recent record of economic liberalization, functioning equity and debt markets, and significant potential for both economic growth and capital market investment by foreigners. In short, an emerging market is a poor country that might be worth investing in. Classic examples include Argentina, Brazil, Mexico, India, and Russia.

27.2.1 Characteristics of Emerging Markets

Financial markets around the world can be broadly classified as pre-emerging, emerging, established, and mature. Countries like Vietnam and Russia would be considered pre-emerging whereas India, Korea, and Thailand would be considered emerging markets. Similarly, Singapore and Hong Kong are established markets and USA and UK are mature markets. The definition of emerging market itself is not very clear. If age is the basis of differentiation, India would be considered mature whereas if sophistication is the basis Japan would not be considered developed because of its open outcry system. The most widely accepted definition of an emerging market is that market which has begun a process of change, and is growing in size and sophistication. Exhibits 27.1 and 27.2 present the characteristics of some of the emerging and developed markets.

27.2.2 Why Invest in Emerging Markets?

Emerging markets are characterized by diversity, volatility, rapid economic growth, and frequently, immature institutions. The Morgan Stanley Capital International

Exhibit 27.1 Characteristics of emerging and developed markets

Country	Mkt Cap $m	Std. deviation	Sep 1995 characteristics	No. of listed companies
Emerging markets				
Argentina	18,783	91.7	Volatile and risky	175
Brazil	106,821	63.1	Lack of investor Protection	565
Colombia	9,079	31.3	Weak Disclosure norms	80
India	66,772	29.2	More regulated	9871
Indonesia	26,995	30.7	–	155
Mexico	65,585	46.2	–	195
Philippines	32,829	36.8	–	170
Developed markets				
Australia	137,352	26.3	More stable	1030
Canada	193,156	19.3	Stringent disclosure norms	1119
Germany	344,087	12.6	Issue costs are high	933
Japan	205,0510	25.0	–	2470
Switzerland	285,171	19.0	–	180
U.K	842,965	21.2	–	7651
U.S	35,40,304	14.8	–	1945

Source: Erb et al. (1996a)

Exhibit 27.2 Economic characteristics of S&P/IFC emerging market countries

Country	Market Cap 1998 $m	GDP 1999 $m
Argentina	45, 332	283, 166
Brazil	160, 887	751, 505
China	231, 322	989, 465
India	105, 188	447, 292
Mexico	91, 746	493, 737
Russian federation	20, 958	401, 442
South Africa	170, 252	131, 127
Average		175, 028

Source: Bruner et al. (2003)

Emerging Markets Index (MSCI EMF), one possible proxy for the asset class, currently contains 730 securities in 26 countries with an aggregate capitalization of $1.1 trillion. Countries run the gamut from Taiwan and Korea, with per capita incomes well in excess of $10,000, to Sri Lanka where per capita income is below $1,000.

Investors choose to invest in international markets for a variety of reasons.

Diversification: The first is diversification. As one would expect, as countries remove capital controls and increase trade openness, the correlation of emerging markets has gradually increased to about .75 with US equities. But, despite their volatility, by adding emerging markets to their portfolio, investors can create more efficient portfolios.

Return enhancement: The second reason for investing in emerging markets has to do with return enhancement. Over the past 15 years, emerging market equities have outperformed global equities by nearly 400 basis points per annum. Each year, one emerging market is frequently the best performing market in the world. Asia, led by China, is and will likely continue to be the world's most rapidly growing region. Output in China is growing at roughly 8% per annum; China represents a favorable shock to both global demand and supply.

Given *faster economic growth* in emerging markets relative to developed markets, fund managers often posit a long-term 1–2% return premium (relative to developed market equities) for emerging market equities. Certainly, emerging markets can have large runs, for example, over the past 2 years (2005–2007) they have returned a cumulative 85%.

Broader opportunity set: International investors shortlist stocks from around the world to create an investment opportunity set. In this sense, it is the companies that emerge, not markets. Gazprom is a Russian company that earns nearly $6 billion a year and supplies roughly 20% of Germany's natural gas reserves. Its natural gas reserves are among the largest in the world.

27.3 Performance of Emerging Markets

While they are known for their risk and volatility, emerging markets – which range from high-profile markets like China and India to the lesser-known markets of South Africa and Morocco – have posted spectacular returns over the last 4 years (Exhibits 27.3 and 27.4). Since the end of 2002, the benchmark MSCI EMF has returned about 235%.

In 2007, Egypt was up by 81%, Hungary by 47%, and Vietnam by 39%. Savvy investors know that the principal of a diversified portfolio extends beyond finding companies in different industries. The dollar's decline has helped a number of overseas markets and apportioning some of your nest egg overseas is just plain prudent. Given strong economic growth in India and China, investing solely in US stocks no longer makes sense for USA or international investors. Emerging market economies are outpacing developed countries in the global economic recovery and may

Exhibit 27.3 The performance of world's stock markets as of June 15, 2007 (in %)

Foreign indexes	1 year	3 Year	5 Year
MSCI Far East Ex Japan (USD)	47.37	27.84	17.55
MSCI EAFE (USD)	34.32	23.04	18.55
MSCI EM Latin America (USD)	82.81	54.73	37.60
MSCI EM (USD)	52.33	36.23	25.56
MSCI Europe (USD)	39.35	25.11	19.91
MSCI North America (USD)	24.65	13.43	11.05
MSCI World (USD)	34.43	23.62	18.96

Exhibit 27.4 Performance of stock markets around the world (2006–2007)

Index	Annual return (%)	Country
DJ Mexico	+17.60	Mexico
DOW	+9.07	USA
S&P 500	+4.68	USA
NASDAQ	+9.08	USA
TSX	+6.73	Canada
Bovespa	+49.96	Brazil
FTSE Eurofirst 300	+4.30	Europe
DAX	+22.83	Germany
FTSE 100	+4.95	UK
FTSE 250	−3.90	UK
CAC 40	+4.17	France
Ibex 35	+10.79	Spain
JSE	+28.26	South Africa
FTSE Xinhua 200	+169.98	China
Hang Seng	+50.85	Hong Kong
S&P/CNX 500	+70.24	India
JSX	+59.28	Indonesia
Nikkei	−4.24	Japan
ASX	+20.86	Australia
NZX	+1.82	New Zealand

Source: www.ft.com

continue to do so for some time. Emerging markets have been on a roll, racking up annualized returns of about 35% – a pace of growth that will be difficult to maintain.

Many international asset management companies like Vanguard, T Rowe Price, and Lazard offer emerging market funds to capture the benefits of international diversification.

27.3.1 The Efficient Frontier with/Without Emerging Stocks

Many fund managers believe that international investments in a portfolio increases diversification, which in turn can reduce overall investment risk. Because the markets of the world do not move in lockstep, a downturn in one country's economy can often be offset by a rise in another.

27.4 Using International Investments to Reduce Volatility

Volatility in a portfolio can increase the risk of loss of principal. While attempting to minimize volatility, some investors choose low-risk securities; however, these securities tend to have lower rates of return.

Professional money managers advise that investors balance their portfolios with some investments with higher growth potential but choose them so that some of the potential fluctuations (risks) cancel each other out. In statistical terms, the goal is a combined standard deviation (standard deviation is a measure of risk in a portfolio) that is low, relative to the standard deviations of the portfolio's individual holdings. The goal is a high average rate of return, with fewer radical fluctuations in value.

27.5 The Efficient Frontier

The optimum combination of asset classes to achieve a given risk versus return scenario in a portfolio is called the Efficient Frontier.

When the rate of return and standard deviations for all the portfolios possible by allocating among a collection of securities (like all the stocks in the S&P 500®) is graphed, the region bounded by an upward-sloping curve is the efficient frontier. The efficient frontier shifts upward if returns are enhanced for the same level of risk because what appears to be systematic risk might be unsystematic country risk at a global level.

27.6 Emerging Economies' Fixed Income and Other Markets

The breadth and depth of the fixed income category has grown over time and emerging markets debt has become a viable asset class of its own.

27.7 The Global Fixed Income Market

Fixed income encompasses a variety of debt obligation types: bonds, loans, bank certificates of deposits, and commercial paper among others. The unifying feature of these products is a legal, contractual obligation for the issuing entity to pay the creditor a stated rate of interest plus the full principal invested over a defined time period. This contractual obligation is what makes fixed income the generally lower-risk asset class when compared with equities. Issuing entities include sovereign and municipal governments, government agencies, corporations, and special-purpose vehicles backed by assets such as mortgages, auto loans, or credit card receivables.

Most tradable fixed income securities have a credit quality rating from a rating agency such as Moody's or Standard & Poors. The rating helps investors assess an individual bond's creditworthiness, or the likelihood that it will fulfill its contractual payment obligations without delinquency or default. A World Bank estimate puts the size of the global bond market at $61 trillion in 2005, making it the world's largest investment market. More than half of that figure is debt issued outside the USA.

By comparison, the size of the world equity market for the same year was $41 trillion. Bond market growth has come from a number of sources, including a proliferation of new product types and an increase in the number of countries able to tap the international sovereign and corporate debt markets.

27.8 Political, Economical, and Legal Risks

Investments in emerging markets are invariably exposed to political risk which includes civil war and unrest, inconvertibility of currency, expropriation of profits, breach of contracts undertaken by government, etc. Obviously, investors are concerned about host country interference which results in higher cost and/or loss of profits. There are many professional political risk measurement services that measure country risk. Some of the popular ones are

- Economist Intelligence Unit
- Institutional Investor
- Euromoney
- Political Risk Services: International Country Risk Guide (ICRG)

Each of the rating providers combines a range of qualitative and quantitative information into a risk measure. For instance, Economist bases its analysis on an index of 100 points with 33 assigned to economic factors, 50 to political factors, and 17 to societal factors. Economist includes the following factors:

Political factors

- Authoritarianism
- Longevity of regime
- War
- Illegitimacy

Economic factors

- Inflation
- Gross domestic product (GDP) per capita
- Food production per capita
- Capital flight
- Foreign debt as a percent of GDP

Societal factors

- Fundamentalism
- Corruption
- Ethnic tension

The institutional investor country risk ratings are based on a survey of 75–100 international bankers who are asked to grade each country on a scale of 0–100

(100 represents maximum creditworthiness). The ratings are published twice a year in March and September. The March 2000 rankings of some countries are given below.[1]

March 2000	September 1999	Country	Credit ranking
1	1	Switzerland	93.8
2	2	Germany	92.9
5		USA	92.9
3	5	France	91.7
7	6	UK	91.1
37	40	China	56.6
48	47	Mexico	49.8
57	57	India	45.3
70	71	Brazil	38.5
89	88	Iran	29.2
134	144	North Korea	6.8
135	145	Afghanistan	5.7

Source: Institutional investor

The Euromoney provides country risk score on the basis of nine categories. They are

- Political risk (25% weighting, 0–10)
- Economic performance (25% weight)
- Debt indicators (10%)
- Debt in default or rescheduled (10%)
- Access to bank finance (10%)
- Access to short-term finance (5%)
- Access to capital markets (5%)
- Discount on forfaiting (5%)

The Euromoney rankings of some countries are given below.[2]

September 1999	Country	Total score
1	Luxembourg	98.68
2	Switzerland	97.79
3	USA	94.51
18	Australia	88.10
50	China	55.09
59	India	51.80
78	Venezuela	41.33
116	Guyana	32.50
117	Algeria	32.32

Source: Euromoney, September 1999

[1] More recent ratings are available on the Institutional Investor Website http://www.iimagazine.com/.

[2] The Euromoney scores are available on the Euromoney Website http://www.euromoney.com/.

ICRG considers 5 financial, 13 political, and 6 economical factors to calculate risk indices in each of these categories and a composite risk score. A higher score indicates lesser risk. The political risk measure is given twice the weight of economic and financial risk. The composite score is a combination of individual indices score.

27.9 Valuation in Emerging Markets

It is now a standard practice to estimate the value of a company's equity by discounting free cash flow to firm by weighted average of cost of capital (WACC) and deducting value of debt on the books of the company or discounting equity cash flows by cost of equity.

$$\begin{aligned}\text{Free cash flow} = {} & \text{EBIT} - \text{Cash taxes} + \text{Depreciation} - \text{Capital expenditure} \\ & - \text{Working capital.}\end{aligned}$$

$$\text{Equity cash flow} = \text{Free cash flow} - \text{Debt service} + \text{New borrowings}$$

The Capital Asset Pricing Model (CAPM) suggests that

$$\text{Cost of equity} = R_\mathrm{f} + \beta\left[\mathrm{E}(R_\mathrm{m}) - R_\mathrm{f}\right]$$

CAPM is appropriate if the portfolio returns can be completely characterized by the mean and standard deviation. A large number of studies have shown that emerging market returns are nonnormal and, hence, cannot be described by mean and variance (Erb et al. 1996b, 1998; Baker and Campbell 1997). Emerging market returns are not only higher than returns from developed markets but also are far more volatile due to economic shocks, military coups, and such other factors. In addition, the mean and variance of returns change over time.

In many emerging countries, the stock markets lack depth. Typically, a handful of companies account for more than half the market capitalization. So the stock market index would be a poor proxy for market portfolio which is supposed to represent the portfolio of all risky assets held by the marginal investor.

A study of emerging market returns suggests that there is no relation between expected returns and beta measured with respect to the world market portfolio (Campbell 1995). Further, according to CAPM, expected return is a function of beta. The beta is measured by analyzing the way the equity returns covary with a benchmark return. In many countries beta cannot be estimated because the equity market does not exist!

One can estimate the beta of the company, if there is a stock market, by regressing stock returns against an international index such as the MSCI EMF.

The risk premium for a company in a non-US country could be expressed as[3]:

$$\text{Risk premium} = \text{base premium for a mature market} + \text{country premium}$$
$$\text{Cost of equity} = R_{\mathrm{f}} + \beta\,(\text{base premium for mature market like USA}) + \text{Country premium}$$

where $R_{\mathrm{f}} = \mathrm{T}$ – bond rate, a proxy for risk-free rate, base premium is the geometric average premium (i.e., $R_{\mathrm{m}} - R_{\mathrm{f}}$) earned by stocks over bonds over a long period of time, 6.1% in case of USA. The country premium is added on the assumption that country risk cannot be diversified due to cross market correlation. Put differently, a major portion of the country risk is systematic. The equity risk premium of a country is a function of country default risk and the volatility of equity market relative to the country bond market.

$$\text{Country equity risk premium} = \text{Country default spread} \times \left[\frac{\sigma_{\text{equity}}}{\sigma_{\text{country bond}}}\right]$$

The country risk can be measured by the credit rating given by international credit rating agencies like Standard & Poor and Moody's.[4] These agencies publish default spread over T-bond rate and spread over corporate bonds with similar rating in USA. Exhibit 27.5 presents the Moody's country ratings and the default spread (at the time of writing). Either the corporate spread or the country spread could be used as default risk premium. The default risk premium should be translated into equity risk premium.

$$\text{Country equity risk premium} = \text{Country default spread} \times \left[\frac{\sigma_{\text{equity}}}{\sigma_{\text{country bond}}}\right]$$

where σ_{equity} is the standard deviation of returns on the country's stock market index and $\sigma_{\text{countrybond}}$ is the standard deviation of country bond prices.

The cost of equity can be used to discount free cash flow to equity investors to value the company's equity.

27.10 The Tactical Case for Emerging Markets

In 2005, emerging markets were selling at about ten times forward earnings, a sharp discount to the forward earnings multiple of developed markets. The outlook for

[3] See Aswath Damodaran, "Estimating Risk premiums," Working Paper, Stern School of Business, n.d. Other approaches for estimating cost of equity in emerging markets are discussed in End of the Chapter Exercises.

[4] See http://www.moodys.com.

Exhibit 27.5 Country ratings and default spread

Country	Long term bond rating[a]	Country risk premium (%)
Argentina	Ba3	4
Australia	Aa2	0.65
Austria	Aaa	0.00
Belgium	Aaa	0.00
Brazil	B2	5.5
Canada	Aa2	0.65
Chile	Baa1	1.2
China	A3	0.95
India	Ba2	3
Indonesia	B3	6.5
Japan	Aa1	0.60
Pakistan	Caa1	7.5
Sweden	Aa2	0.65
Switzerland	Aaa	0.00

Source: Aswath Damodaran, "Estimating Risk Premiums", Unpublished Working Paper, Stern School of Business, Undated

[a]Spread between interest on foreign currency country bond and that on US corporates with similar rating

Exhibit 27.6 The tactical case for global emerging markets (times)

	P/E		P/BV		EV/EBITDA	
	10^4	10^5	10^4	10^5	10^4	10^5
Latin America	10.2×	8.7×	1.7×	1.5×	5.2×	4.6×
EMEA	9.0×	8.5×	1.5×	1.3×	5.0×	4.5×
Asia	9.5×	9.0×	1.8×	1.6×	5.3×	5.0×
GEM	9.5×	8.8×	1.7×	1.5×	5.2×	4.8×
US	18.0×	16.3×	2.7×	2.3×	8.9×	8.1×
Europe	13.2×	12.0×	1.8×	1.7×	6.7×	6.3×
Developed Asia	16.9×	15.3×	1.6×	1.5×	7.7×	7.1×
Global	14.9×	13.5×	2.1×	1.9×	7.4×	6.8×
GEM discount (%)	−36.5	−34.9	−18.1	−21.0	−29.4	−29.4

Source: Charlemagne Capital

global economic activity in 2005 was strong. And Asian currencies were/are likely to continue to appreciate over time. While it is unrealistic to expect returns from emerging markets like the last 2 years, emerging markets are attractively valued in a global context. A comparison of valuation ratios for the world's markets is presented in Exhibit 27.6.

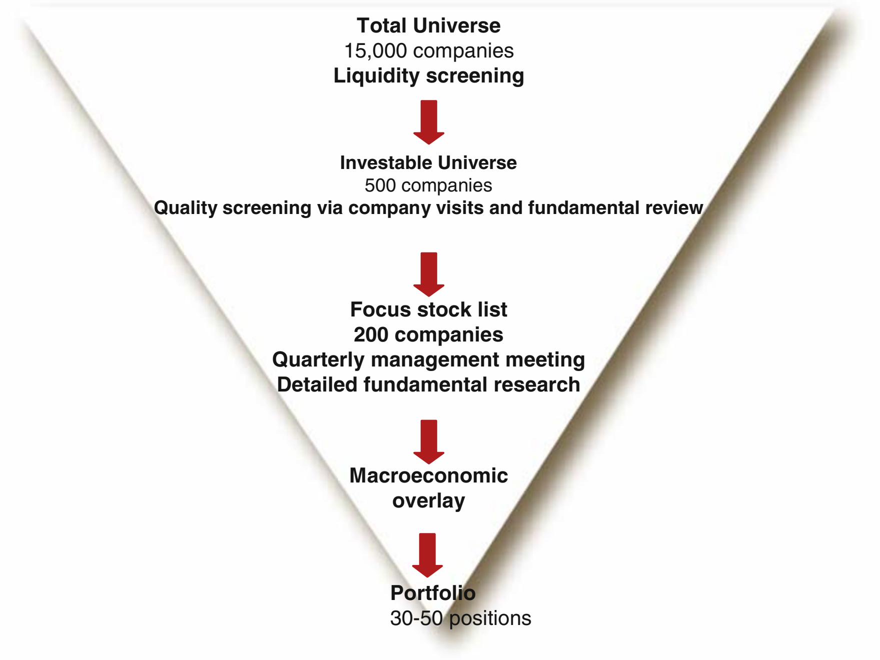
As pointed out in the chapter on valuation using multiples, it is incorrect to compare multiples across companies or, by extension, markets. Markets differ in their investment characteristics because of which we would expect them to sell at different multiples.

27.11 A Framework for Asset Allocation

Multinational fund managers have access to stocks from around the world. As pointed out earlier, it is the companies that emerge, not markets. That is, fund managers, screen companies from around the world. Exhibit 27.7 presents a framework for constructing portfolios out of stocks chosen from the world. In the first step about 15,000 companies are screened for liquidity.[5] About 500 companies are chosen from this universe on the basis of fundamental analysis, including company visits. Two hundred companies are chosen for detailed analysis. The company analysis is used along with macroeconomic analysis to come up with 30–50 positions.

International fund managers use a variety of criteria for investment in companies in emerging markets. Given below is a small checklist.

Exhibit 27.7 Framework for investment process



[5] The definition of liquidity varies across funds. Maverick Capital, for instance, defines sufficient liquidity as trading more than $10 million in value a day. About 2,200 stocks satisfy this criterion. Charlemagne Capital, on the other hand, considers about 15,000 companies.

Checklist	Explanation
Management quality	Corporate governance, track record, strategy, shareholder value focus
Top line growth	Market leadership, innovative products
Earnings growth/quality	Lean cost management, consistent operating earnings growth
Cash flow generation	Sufficient internally generated cash flow
Balance sheet strength	Easy access to finance, low solvency risk

They also apply both absolute and relative analysis. The outcome of this result is a price target for the company.

Relative analysis	Absolute analysis
Traditional ratio analysis	Discounted cash flow (DCF)/Dividend Discount Model (DDM)
Versus sector	Sum of the parts
Versus market	
Price target	

27.12 Concluding Comments

Several themes will characterize emerging markets investing in the decade ahead. These include the rise of China as a global manufacturing center, the growth of inter-Asian trade, the emergence of Russia as major energy supplier, the enlargement of the European Union (EU), outsourcing, and the wiring of the emerging world, to name a few. Most investors continue to be underweight in non-US equities and, in particular, emerging markets. Political and other risks in emerging markets are substantial, and investors should carefully limit their allocations. But adding emerging markets to a portfolio can both increase return and diversify risk.

27.13 End of the Chapter Exercises

1. Define emerging markets.
2. Why do international investors choose to invest in emerging markets?
3. What are the risks in investing in emerging markets?
4. What are some of the valuation issues in emerging markets?

References

Bruner R et al (2003) Investing in emerging markets. The research foundation of AIMR, Charlottesville, Virginia

Beaker G, Campbell H (1997) Emerging Equity Market Volatility, Working Paper, Duke University, Fuqua School of Business; National Bureau of Economic Research (NBER)

Campbell HR (1995) Predictable risk and returns in emerging markets. Rev Financial Stud 8:773–816

Cavaglia S et al (2004) Investing in global equities. J Portfolio Manage Spring:88–94

Damodaran A (n.d) Estimating risk premiums. Unpublished Working Paper, Stern School of Business

Erb CB, Campbell H, Tadas V (1996a) Expected returns and volatility in 135 countries. J Portfolio Manage Spring

Erb CB, Campbell H, Tadas V (1996b) Political risk, economic risk and financial risk. Financial Anal J November/December

Erb CB, Campbell H, Tadas V (1998) Risk in emerging markets. Financial Surv July–August

Global Emerging Markets Presentation, Charlemagne Capital, September 2004

Masters S (2002) Emerging markets. J Portfolio Manage Spring

Saunders A, Ingo W (2002) Are emerging market equities a separate asset class? J Portfolio Manage Spring

Wilcox J (1992) Global investing in emerging markets. Financial Anal J January–February

Chapter 28
Behavioral Finance and Investment Strategy

Chandrasekhar Krishnamurti

28.1 Chapter Introduction and Objectives

Many great minds, both academics and practitioners, have examined the financial markets in hopes of finding investment strategies that yield the nest results. And nearly all have based their theories on one assumption that investors always act in a manner that maximizes their returns. Yet volumes of research show that investors are not always so rational.

Clearly, not every choice investors make is in their best interest. While emotions like fear and greed play a role in poor decisions, there are other causes of irrational behavior. Behavioral finance is the study of how these emotions and mental errors can cause stocks and bonds to be overvalued or undervalued. It has led to the creation of investment strategies that capitalize on this irrational behavior.

This chapter has the following objectives:

- Introduce the application of behavioral finance in constructing investment strategies
- Describe the typical errors in investors' information processing
- Describe some of the commonly encountered behavioral biases of investors
- Explain the limits to arbitrage
- Reconcile market efficiency and behavioral finance

In the chapters that preceded, we presented two broad approaches to security analysis. *Fundamental analysis* involves analysis of financial statements, strengths, and management quality of a firm and its competitors and markets. *Technical analysis* maintains that all information is reflected already in the stock price, so fundamental analysis is a waste of time. Technical analysis does not care what the intrinsic value of the stock is. Its price predictions are extrapolations from historical price patterns.

C. Krishnamurti
Mail Number B-3, Business School, AUT University, Private Bag 92006, Auckland 1142, New Zealand
e-mail: Chandrasekhar.krishnamurti@aut.ac.nz

S.R. Vishwanath, C. Krishnamurti (eds.), *Investment Management: A Modern Guide to Security Analysis and Stock Selection,* DOI: 10.1007/978-3-540-88802-4_28,

A third branch called behavioral finance has emerged in the recent years as the third approach to investment analysis. It uses psychology to explain investor behavior that cannot be explained with traditional financial and economic theory.

Traditional economic theory rests on the sensible assumption that investors make purely rational decisions. A rational decision, as defined by an economist, is one that maximizes an investor's utility function. This simply means that when presented with a choice an investor will always choose the course of action that will gain the most for expending the least. Thus, it is a decision supported by logic and reason and is, therefore, deemed "rational" by economists. With this assumption made, economists were then free to develop mathematical models that now provide investors with the necessary tools to price assets, optimize portfolios, and quantify and manage risk – all valuable contributions and significant achievements.

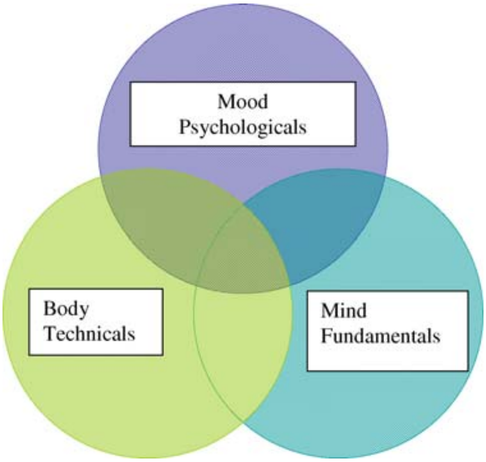
But was their underlying assumption correct? Do investors actually make purely analytical decisions devoid of emotion? Studies analyzing historical trades generated by both retail investors as well as professional traders reveal that, in fact, they do not. On the contrary, does this mean the pendulum swings completely the other way and the opposite is then true? Do investors make wild, unpredictable, or unexplainable decisions? No, this is not the case either. Behavioral finance, by utilizing the insights of psychology, provides the explanation.

In the same way that the fields of macroeconomics and microeconomics simply reflect different scales or cosmoses of activity, man, or the individual investor, is a microcosm of the market as a whole. That is, the rationalization, psychology, and investing behavior of an individual investor is directly related to the thinking, feeling, and acting of all investors. The aggregate of all investors is, of course, the market itself. Thus, the best guide to how markets function is man himself. Indeed, human beings are the sole causal factors of the market. There is nothing in the market that is not a reflection of human behavior.

The history of markets can even be seen as a complex set of recurrent human errors. We know the market habitually overreacts or underreacts. Behavioral finance provides an alternative explanation to some of the anomalies outlined in the chapter on market efficiency. It takes into account how real (different) people make decisions. Some of the irrationalities may arise because investors do not always process information correctly, and, hence, derive incorrect future distributions of returns. This results in arbitrage opportunities. Even while knowing the true distribution of returns, investors can make suboptimal decisions. Consequently, arbitrage is limited. Hence, the absence of arbitrage opportunities does not necessarily imply market efficiency.

There are three different and distinct symptoms of the market which correspond to how participants feel (psychologicals), think (fundamentals), and act (technicals). By studying and measuring these three components, experts in behavioral finance arrive at a comprehensive analysis of the market. Each of these market functions are always in disequilibria to some degree. These persistent disequilibria result in systemic investing errors. Identifying the errors of other market participants, in turn, leads to investment opportunities. Exhibit 28.1 presents the link between fundamental analysis, technical analysis, and behavioral finance approaches.

Exhibit 28.1 The link between fundamental analysis, technical analysis, and behavioral finance



Some central issues in behavioral finance are why investors and managers (and also lenders and borrowers) make systematic errors. It shows how those errors affect prices and returns (creating market inefficiencies). It shows also what managers of firms or other institutions, as well as other financial players, might do to take advantage of market inefficiencies.

28.2 Information Processing

The anomalies outlined in the chapter on market efficiency could be due to any number of factors. Behavioral finance provides an insight into how investors process information and how this process can contribute to systematic errors. The following are some of the patterns in investor behavior.

Forecasting errors: People tend to give too much weight to recent experience compared to prior beliefs. This is known as *memory bias.*

Overconfidence: People tend to overestimate the precision of their predictions and their abilities which is why active management is more prevalent than passive (less than 10% of funds in passive mutual funds).

Conservatism: Investors are too slow to update their beliefs in response to recent evidence. That is, the adjustment is gradual.

Sample size neglect and representativeness: Investors tend to ignore the fact that some decisions are based on small samples and regard them as representative. As they realize their errors, corrections occur. This results in reversals (e.g., stock price reversals).

28.3 Behavioral Biases

Investors often make suboptimal decisions but they have great reasons for making these poor decisions. And these reasons are not random or unpredictable but are manifestations of the investor's embedded psychological biases.

Given below are some well-documented psychological biases known to affect investors' judgment.

Loss aversion: People are afraid of losses. They derive more disutility from loss than utility from gain. This asymmetry creates asymmetrical return probability curve as shown in Exhibit 28.2.

Disposition effect – *Selling winners early and holding losers too long*: People naturally seek pride and avoid regret. Selling an investment for a gain confirms that the investor's original decision was correct and yields pride. By contrast, selling an investment at a loss painfully admits that they made a mistake and produces regret. Not surprisingly, investors eagerly sell winners and reluctantly sell losers.

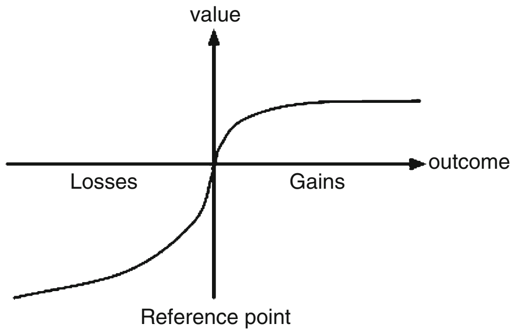
Framing: Decisions seem to be affected by the way they are framed (win vs lose). For example, people prefer a discount at off-peak times to a peak time surcharge even if the prices are identical. Similarly, people prefer to hear about "survival probability" rather than "mortality rates" even though the two add up to 100%.

Individuals tend to be risk averse in gains but risk lovers in losses. After earning a profit, people are willing to take more risk. This is described as the "house money effect" by gamblers because of the known tendency to play more carelessly with winnings than their original money. Similarly, investors may invest their profits into riskier securities.

Mental accounting: Investors tend to separate their decisions for different "accounts" rather than regard their holdings as one portfolio.

Representativeness: There are dozens of mental shortcuts that make it hard for investors to correctly analyze new information. The brain assumes that items, people, stocks, etc. with a few similar traits are likely to be identical even though they

Exhibit 28.2 Pictorial representation of loss aversion



may be quite different in reality. While representativeness helps the brain organize and quickly process large amounts of data, it is a shortcut that can cause investors to overreact to old information.

If stock markets generate high returns for a particular time period, investors tend to believe that high returns are normal although there is no guarantee that past performance is an indicator of future.

Fingerhut was trading at ~$ 30 a share in 1994 before embarking on a 2-year slide that dropped its stock price into the mid-teens. Despite an economic boom, sales and margins for the mail-order catalogue company decreased. And the company became known in the investment community as one to avoid.

In early 1999, however, the company announced it was developing an on-line trading department that could potentially expand its audience and boost its earnings by several times. Company insiders, including a senior vice president and four directors, started buying stock. Increased sales and other fundamental signals of improvement also started to appear.

But the company's stock price did not rise much initially despite the new information. Investors overreacted to the old information and remained convinced that the company would continue to perform poorly, much like it had over the past 2 years, creating an opportunity for rational investors to exploit the market's bias against the stock. Between July 1996 and April 1999, the stock rose from $ 15 to $ 25. The company also spun off Metris Companies Inc. during this period, adding an additional $ 18 per share to shareholder return. The company was acquired in April 1999 by Federated Department Stores Inc.[1]

Regret avoidance: If decisions turn out bad, individuals regret more the "unconventional" decisions (e.g., blue chips).

Magical thinking: Magical thinking describes the tendency for people to erroneously believe that their involvement or actions will positively affect the outcome of an event for their benefit even when the event's outcome is known to be purely random. Research has shown that when asked to sell their lottery ticket people demand a price that is on average four times greater if they personally chose the numbers themselves than if they possess a ticket to which the numbers were randomly assigned. Clearly, each ticket's odds of winning are equal. But the lottery player perceives their selections somehow increased the odds in their favor. Similarly, investors may incorrectly feel that by personally selecting an investment it has an improved chance for success.

A related phenomenon is overconfidence. Investors are overconfident of their abilities. This may lead them to invest in only those stocks that they are familiar with even if it results in poor diversification.

Research shows that men are more overconfident than women. The more people trade, the worse they do, on average. And men trade more, and do worse than women, on average.

[1] http://www.undiscoveredmanagers.com.

28.4 Mutual Fund Performance

As pointed out in the chapter on market efficiency most funds do not outperform the market, but there seemed to be some persistence in performance.

There are not more than five funds that have beaten the S&P 500 by 2% points or more since the 1970s. Active mutual funds underperform a low-cost index mutual fund, on average. The typical active fund charges 140 basis points in expenses and the index fund charges less than 20 basis points. In addition, there are other transaction costs like the bid–ask spread that managers face when they buy and sell stocks. Consequently, a median active fund underperforms by 200 or more basis points.

The top funds in one period are often the bottom funds in the next period. This evidence is often quoted as a sign of market efficiency.

In order to evaluate funds better, we can look at the alpha coefficients [from Capital Asset Pricing Model (CAPM)]. Funds seem to have an almost zero mean (slightly negative in fact). But the problem is that indexes such as the S&P 500 might not be the most appropriate "market index" (as it consists of mostly big firms). The CAPM is based on the concept of "market portfolio" that includes all assets in the economy, not just stocks. Some studies of mutual fund performance have used multifactor index models (e.g., Fama–French). There is still evidence of underperformance (on the average) relative to market. As for consistency, it seems like most of it is in *negative* results. Further, very few managers compiled career "winning" records. The evidence from bond funds is even more supportive of the efficient-market hypothesis (EMH).

28.5 Limits to Arbitrage

It is quite possible that the market over- or undervalues securities. But the pricing inefficiencies do not present risk-free profit opportunities. Investors might not take advantage of them if it involves taking "too much risk." The second reason for limited arbitrage is trading costs (e.g., short sales) can reduce net profits from mispricings. Third, investors worry that the model that predicts the profit opportunity might not be accurate.

In a round table discussion on *Market Efficiency and Behavioral Finance* (2005), Professor Malkiel of Princeton University, the author of *A Randon Walk Down Wall Street*, narrates an interesting story of a situation in which implementing an arbitrage opportunity was not possible.

In late-1999, 3Com, which owned Palm Pilot, spun off 5% of its Palm Pilot shares. Palm Pilots were becoming popular then. The market value of Palm Pilot shares that 3Com owned were twice what 3Com was selling for in the market! So Professor Malkiel went to his broker and told him that he wanted to short Plam Pilot and buy 3Com. But the broker informed him that a lot of people in the hedge fund area had been asking him to do the same thing, and there were not enough

Palm Pilot shares to borrow to effect arbitrage. When there is an imperfection in the market, lots of people see it and try to act on it, which is why it is hard to beat the market.

28.6 Behavioral Finance and Market Efficiency

The plethora of research on security prices and anomalies has cast doubt on the efficiency of markets. In this section we reconcile the views of the EMH and behavioral finance. EMH suggests that prices include all the information. Hence, there are no "easy" profit opportunities. Behavioral finance suggests that prices can be "wrong," but there are still no "easy" profit opportunities. Hence, not observing easy profits *does not* imply that prices are "right" (i.e., EMH holds). However, the inconsistencies in behavioral finance explanations (evidence of both under- and overreaction) are too unstructured.

28.7 Concluding Comments

Several asset management companies and consultants have started offering behavioral finance products.[2] It is important to understand that there is overwhelming evidence to support both the EMH and the behavioral finance models. One reason why behavioral finance is considered hot but not implemented by many investors is that it is easy to write a story after observing an event but hard to point out which behavior will dominate ex-ante (some academic papers have examined this as well). Nevertheless, behavioral insights are important.

Behavioral finance offers investors this advice – "know thyself." By exposing an investor's ingrained flaws it affords them the opportunity to reduce their destructive impact. And far from contradicting or undermining traditional financial and economic theory, behavioral finance confirms their worth. Rational decision making maximizes wealth, but it may not be our natural instinct.

However, as behavioral finance warns, we must still guard against the harmful effects of our innate psychological biases – no one is immune. Fortunately, these biases lead to predictable and, therefore, avoidable mistakes. Wise investors must be self-aware and understand that human judgment can be both an asset as well as a potential liability.

The market is competitive and "efficient" enough so that the margin of skill a professional can add is so small that it cannot be detected by statistics.

[2] See, for example, Baker and Sesia (2007).

28.8 End of the Chapter Exercises

1. Define behavioral finance.
2. Describe the biases in investors' information processing.
3. What are some of the biases in investors' judgment?
4. Why it might be difficult to implement arbitrage opportunities in real life?
5. You are given the following information[3]:
   Sally is quite, studious, and very concerned with social issues. When an undergraduate she majored in English literature and environmental issues.
   Given this information, indicate which of the following three cases is most probable?
   (a) Sally is a librarian
   (b) Sally is a librarian and a member of Sierra Club
   (c) Sally works in the banking industry
6. Explain how behavioral finance can be applied in constructing investment strategies.
7. Is behavioral finance consistent with market efficiency? Why or why not?

References

Baker M, Sesia A (2007) Behavioral finance at J P Morgan. HBS Case Study 9-207-084
Barber BM, Odean T (2000) Trading is hazardous to your wealth: The common stock investment performance of individual investors. J Finance 55
Barber B, Odean T (2001) Boys will be boys: Gender, overconfidence, and common stok investment. Quart J Econ 116
Barberis N, Thaler R (2003) A survey of behavioral finance. In: Constantinides G, Harris M, Stulz R (eds) Handbook of the economics of finance. North Holland, Amsterdam
Burton M, Mullainathan S (2005) Market efficiency versus behavioral finance. J Appl Corpor Finance17:3
Fama E (1998) Market efficiency, long-term returns and behavioral finance. J Financial Econ 49
Froot K, Debora E (1999) How are stock prices affected by the location of trade? J Financial Econ 53
Owen AL, Thaler RH (2004) Can the market add and subtract? Mispricing in tech stock carve-outs. J Polit Econ 111
Ritter J (2003) Behavioral finance. Pacific Basin J 11:4
Shefrin H (2000) Beyond fear and greed. HBS, Boston
Shleifer A, Vishny R (1997) The limits of arbitrage. J Finance 52
Statman M (1999) Behavioral finance: past battles and future engagements. Financial Anal J November–December
Subrahmanyam A (2007) Behavioral finance: a review and synthesis. Eur Financial Manage 14:1
Thaler R (1999) The end of behavioral finance. Financial Anal J November–December

[3] This question has been adapted from "Introduction to behavioral finance," Undiscovered managers LLC, 1999.