SIXTH EDITION

An Introduction to Derivatives & Risk Management

Don M. Chance

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Louisiana State University

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Each time the planning begins for a new edition of this book, I worry. I hope that, on the one hand, there will be enough new material to justify a new edition, and on the other, that I can distinguish the new edition from the last one without alienating instructors whose teaching notes closely follow the book.

On the first item, I find that there is rarely a shortage of new material. The derivatives and risk management industry is so dynamic. Moreover, users and reviewers of this book provide me with excellent comments and suggestions for new material and modifications to existing material. I only wish I could use every idea they offer, but of course, you wouldn't want a book that rivals the IRS tax code in size.

On the second matter, I have worked hard to keep the basic structure of the book intact. Options come first, followed by forwards and futures. Next we take up swaps and then various advanced instruments. Finally, we cap it off by covering risk management. But the demands for new material, particularly the need for increased emphasis on swaps, have dictated some significant changes in structure to this book. Instructors have told us that swaps are so important that they need a chapter all of their on. So we have given them one, consolidating interest rate, currency, and equity swaps into a single chapter with increased coverage of each. Given that change, however, other significant changes were necessary.

In previous editions of this book, currency derivatives and options on futures had their own chapters. Now these instruments are integrated throughout the book. Currency options are covered with options (chapters 2–6), currency forwards and futures are covered with forwards and futures (chapters 7–11), and currency swaps are covered with swaps (chapter 12). Options on futures, however, cannot be covered in the options chapters, because at that point, futures have not been covered. Thus, options on futures are covered in the futures chapters (7–11). These changes are not only necessary, but they represent substantial improvements in how these instruments should be viewed, studied, and learned.

There was a time when currency derivatives had to be treated as instruments quite distinct from derivatives on other underlyings. But in this day and age of integrative global finance, a currency should just be viewed as another underlying, no more complicated than a stock or bond. Anyone who would claim to be knowledgeable in derivative instruments must have the ability to move easily from currency derivatives to other types of derivatives. And options on futures are just options where the underlying happens to be a futures contract. With options covered first, these instruments can be easily introduced as soon as futures are covered without causing any problems.

Another major change is that the final and formerly quite lengthy chapter on risk management is now split into two chapters, the first focusing on quantitative techniques and the second of a more qualitative nature.

Organization of the Book

This book is divided into three main parts. First there is an introductory chapter, which gives an overview of the subject. Then Part I, consisting of Chapters 2–7, covers options. Chapter 2 introduces the basic characteristics of options and their markets. Chapter 3 presents the fundamental principles of pricing options. These principles are often called boundary conditions, and while we do tend to think of them as fundamental, they are nonetheless quite challenging. Chapter 4 presents the simple binomial model for pricing options. Chapter 5 covers the Black-Scholes model, which is the premier tool for pricing options and for which a Nobel Prize was awarded in 1997. Chapters 6 and 7 cover option trading strategies.

Part II covers forwards, futures, and swaps. It begins with Chapter 8, which introduces the basic characteristics of forward and futures markets. Chapter 9 presents the principles

for pricing forwards, futures, and options on futures contracts. Chapter 10 covers hedging strategies, which is the primary use of these contracts. Chapter 11 covers some advanced applications of futures. Chapter 12 is devoted to swaps, including interest rate, currency, and equity swaps.

Part III deals with various advanced topics, although one should not get the impression that the material is particularly complex. Chapter 13 deals with interest rate derivatives, such as forward rate agreements, interest rate options, and swaptions. Chapter 14 covers some advanced derivatives and strategies, which are mostly extensions of previous topics and strategies. Chapters 15 and 16 deal with risk management. Chapter 15 covers quantitative risk management, emphasizing such topics as Value-at-Risk, delta hedging, and managing credit risk. Chapter 16 is more qualitative and focuses on the issues that must be addressed in an organization so that risk management is properly conducted. You will have the opportunity to learn how risk management is done well in organizations and how it is done poorly.

Key Features of the Book

Some of the key features of the book are:

- An emphasis on practical application of theory; all ideas and concepts are presented with clear illustrations. You never lose touch with the real world.
- Minimal use of technical mathematics. While derivatives is unavoidably a technical subject, calculus is not necessary to learn the material at this level. (Note: Some calculus is used in appendices, but this material is not essential.)
- Balanced emphasis on strategies and pricing.
- The book is liberally illustrated with over 100 figures and supported with over 100 tables.
- Over 300 end-of-chapter questions and problems allow you to test your skills (solutions are available to adopting instructors).
- Over 200 margin notes, which are short (a few sentences) summaries of key points, are found throughout.
- Key terms. At the end of each chapter is a list of important terms you should be able to define before going on. These terms correspond to bolded words within the chapter. These average 18 per chapter.
- Quotes to start each chapter. While introductory students may not always catch the meaning behind quotes, they all have some meaning related to the topic of the chapter. The individuals cited are quite a varied bunch, but are mostly practitioners in the field.
- Downloadable Software: The product support Web site **(http://chance.swlearning.com)** contains a downloadable Windows program and various Excel spreadsheets. Throughout the book there are sections called Software Demonstrations that contain explicit illustrations of how to use the software.
- Appendices containing lists of formulas and references.
- A glossary defines several hundred terms.
- A comprehensive index, of course.
- PowerPoint® Presentation, which is available for instructors adopting the book. Some other PowerPoint presentations that I have seen with finance textbooks are mostly just outlines; these contain much more detail. This is available from the product support Web site.
- An *Instructor's Manual* which contains answers to the end-of-chapter questions and problems and true-false and multiple choice tests.
- A Web site **(http://chance.swlearning.com)** that contains the PowerPoint slides, the Windows program, Excel® spreadsheets, and links to relevant Internet sites. The site also provides restricted access to an electronic verion of the Instuctor's Manual, available in Word and Adobe Acrobat format. It also contains updated information and errata. Yes, the book will probably have some errors, but at least I'm willing to tell you about them.

I cannot emphasize too much how I think this book blends theory and practice. All points are illustrated as much as possible using practical situations. For example, the

option results are covered by following a single company's options throughout the book. When strategies are covered, we learn the theory, examine the algebraic equations that describe what is happening, and observe the results either with a table or graph.

Specific New Features of the Sixth Edition

For those familiar with previous editions, the following are new features:

- Separate chapters on swaps and interest rate derivatives
- Integration of currency derivatives and options on futures throughout the book
- Two chapters on risk management
- Improvements to the spreadsheets, making them easier to use
- New software, including a Black-Scholes Excel function that calculates the option price in a single cell, which can be easily imported into other spreadsheets; a new teaching tool spreadsheet that illustrates the dynamics of option boundary conditions, and an implied volatility spreadsheet
- Elimination of the Derivatives in Action boxes, which are replaced by a new type of box called Derivative Tools: Concepts, Applications and Extensions. This new feature provides discussion of additional topics that fill in basic material; show applications or material covered in the chapter; or extend the concepts to more advanced topics
- Coverage of weather derivatives, energy derivatives, real options, contingent-pay options, the CBOE volatility index, and the application of options to the pricing of equities and credit risk

Another important feature of the sixth edition is that this is the first edition in the history of this book that does not feature options and futures pages out of *The Wall Street Journal*. In this day and age of the Internet, looking up day-old prices of options and futures in the *Journal* or any other newspaper is not the best way to do it. More information and more current information can be obtained from the Web sites of the *Journal* and the various options and futures exchanges. Although almost no one seems to need to be taught how to find anything on the Internet these days, nonetheless the book does walk you through the process of finding options and futures prices on the information superhighway.

Use of the Book

The ideal use of this book, and almost all finance textbooks, is in a two-semester course. A full academic year gives an excellent opportunity to cover the subject matter without flying at breakneck speed. Each semester can consist of eight chapters, leaving some time for quizzes, exams, and other in-class activities, such as watching a video or engaging in a trading exercise. If, however, this book is used for only a one-semester course, instructors should find it sufficiently flexible to pick and choose chapters. There is a tendency for one-semester courses to just cover the chapters in the order in which they appear. My own recommendation is that a one-semester course should be sure to include swaps. The swap is the most widely used derivative and the one most likely to be encountered by those who go out into the corporate world. Thus, the instructor might wish to make a special effort to cover Chapter 12, which would probably not be covered if the syllabus just followed the sequence of chapters. In addition to swaps, a one-semester course should probably include interest rate options, which are also likely to be encountered in the corporate world. To make room for these topics, the instructor might need to de-emphasize futures and possibly even cut down on coverage of option strategies. Chapters 14, 15, and 16 would be the lowest priority chapters to force into a one-semester course.

Although the primary audience is the university-level undergraduate, this book has been widely used at the MBA level, including some very prestigious universities' MBA programs. Instructors should not hesitate to adapt the book to an MBA course. The book has also been used in corporate training programs.

Acknowledgments

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I thank my wife Jan and my children Kim and Ashley for their time, love, and support. They have come to take book revisions as a necessary distraction that results in excessive clutter in my home office every few years.

I had always felt that the errors in a book should, through attrition over the years, disappear. I have learned otherwise. Although no one wants errors to remain, if you ever find a book in its sixth edition without any errors, you can be assured that the author is simply correcting old material and not keeping the book up-to-date. With a field as dynamic as derivatives, extensive changes are inevitable. Despite Herculean efforts to cleanse this work, there are surely some errors remaining. I feel fairly confident, however, that they are not errors of fact, but merely accidental oversights and perhaps typos that just did not get caught as I read and re-read the material. Unlike most authors, who I think would rather hide known errors, I maintain a list of the errors on the book's Web site. (Again, that's http://chance.swlearning.com for the general site that links you to the error page.) If you see something that does not make sense, check the Web address mentioned above and see if it's there. If not, then send me an email by using the *Talk to Us* form on the book's Web site.

Or just send me an email anyway, students or faculty. Tell me what you like or don't like about the book. I would love to hear from you.

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Man does not live by stocks and bonds alone.

Chicago Mercantile Exchange advertisement

Introduction

Chapter 1

The speed of money is faster than it's ever been.

Loleen Doerrer
Time, April 11, 1994, p. 33

In the course of running a business, decisions are made in the presence of risk. A decision maker can confront one of two types of risk. Some risks are related to the underlying nature of the business and deal with such matters as the uncertainty of future sales or the cost of inputs. These risks are called **business risks.** Another class of risks deals with the uncertainty of such factors as interest rates, exchange rates, stock prices, and commodity prices. These are called **financial risks.** Most businesses are accustomed to accepting business risks. Indeed the acceptance of business risks and the potential rewards that can come with it are the foundations of capitalism.

But financial risks are a different matter. The paralyzing uncertainty of volatile interest rates can cripple the ability of a firm to acquire financing at a reasonable cost, which will enable it to provide its products and services. Firms that operate in foreign markets can have excellent sales performance offset if their own currency is strong. Companies that use raw materials can find it difficult to obtain their basic inputs at a price that will permit profitability. Managers of stock portfolios deal on a day-to-day basis with wildly unpredictable and sometimes seemingly irrational financial markets.

Although our financial system is replete with risk, it also provides a means of dealing with risk, in the form of derivatives. **Derivatives** are financial instruments whose returns are derived from those of other financial instruments. That is, their performance depends on how other financial instruments perform. Derivatives serve a valuable purpose in providing a means of managing financial risk. By using derivatives, companies and individuals can transfer, for a price, any undesired risk to other parties who either have risks that offset or want to assume that risk.

Although derivatives have been around in some form for centuries, their growth has accelerated rapidly during the last 20 years. They are now widely used by corporations, financial institutions, professional investors, and individuals. Certain types of derivatives are traded actively in public markets, similar to the stock exchanges with which you are probably already somewhat familiar. The vast majority of derivatives, however, are created in private transactions in over-the-counter markets. Just as a corporation may buy a tract of land for the purpose of ultimately putting up a factory, so may it also engage in a derivatives transaction. In neither case is the existence or amount of the transaction easy for outsiders to determine. Nonetheless, we have fairly accurate data on the amount of derivatives activity in public markets and reasonably accurate data,

Chapter Objectives

- To provide brief introductions to the different types of derivatives: options, forward contracts, futures contracts, options on futures, and swaps
- To reacquaint you with the concepts of risk preference, short selling, the risk-return relationship, and market efficiency
- To define the important concept of theoretical fair value, which will be used throughout the book
- To explain the relationship between spot and derivative markets through the mechanisms of arbitrage, storage, and delivery
- To identify the role that derivative markets play through their four main advantages
- To address some criticisms of derivatives

based on surveys, on the amount of derivatives activity in private markets. We shall explore the public market data in later chapters. If you need to be convinced that derivatives are worth studying, consider this: *The Bank for International Settlements of Basel, Switzerland, estimated that at the end of 2001, over-the-counter derivatives contracts outstanding worldwide covered underlying assets of over $111 trillion. In comparison, gross domestic product in the United States at the end of 2001 was about $10 trillion.* As we shall see later, measuring the derivatives market this way can give a false impression of the size of the market. Nonetheless, the market value of these contracts totals about $3.8 trillion, making the derivatives market a sizable force in the global economy.

This book is an introductory treatment of derivatives. Derivatives can be based on **real assets,** which are physical assets and include agricultural commodities, metals, and sources of energy. Although a few of these will come up from time to time in this book, our focus will be on derivatives on **financial assets,** which are stocks, bonds/loans, and currencies. In this book you will learn about the characteristics of the institutions and markets where these instruments trade, the manner in which derivative prices are determined, and the strategies in which they are used. Toward the end of the book, we shall cover how derivatives are used in managing the risk of a company.

This chapter welcomes you to the world of derivatives and provides an introduction to or a review of some financial concepts that you will need to understand derivatives. Let us begin by exploring the derivatives markets more closely and defining what we mean by these types of instruments.

Derivative Markets and Instruments

In the markets for assets, purchases and sales require that the underlying good or security be delivered either immediately or shortly thereafter. Payment usually is made immediately, although credit arrangements are sometimes used. Because of these characteristics, we refer to these markets as **cash markets** or **spot markets.** The sale is made, the payment is remitted, and the good or security is delivered. In other situations, the good or security is to be delivered at a later date. Still other types of arrangements let the buyer or seller choose whether or not to go through with the sale. These types of arrangements are conducted in derivative markets.

In contrast to the market for assets, derivative markets are markets for contractual instruments whose performance is determined by how another instrument or asset performs. Notice that we referred to derivatives as contracts. Like all contracts, they are agreements between two parties—a buyer and a seller—in which each party does something for the other. These contracts have a price, and buyers try to buy as cheaply as possible while sellers try to sell as dearly as possible. This section briefly introduces the various types of derivative contracts: options, forward contracts, futures contracts, and swaps and related derivatives.

Options

An **option** is a contract between two parties—a buyer and a seller—that gives the buyer the right, but not the obligation, to purchase or sell something at a later date at a price agreed upon today.

The option buyer pays the seller a sum of money called the price or premium. The option seller stands ready to sell or buy according to the contract terms if and when the buyer so desires. An option to buy something is referred to as a **call;** an option to sell something is called a **put.** Although options trade in organized markets,

a large amount of option trading is conducted privately between two parties who find that contracting with each other may be preferable to a public transaction on the exchange. This type of market, called an over-the-counter market, was actually the first type of options market. The creation of an organized options exchange in 1973 reduced the interest in over-the-counter option markets; however, the over-the-counter market has been revived and is now very large and widely used, mostly by corporations and financial institutions.

Most of the options that we shall focus on trade on organized options exchanges, but the principles of pricing and using options are pretty much the same, regardless of where the option trades. Most of the options of our interest are for the purchase or sale of financial assets, such as stocks or bonds. There are, however, also options on futures contracts, metals, and foreign currencies. Many other types of financial arrangements, such as lines of credit, loan guaranties, and insurance, are forms of options. Moreover, stock itself is equivalent to an option on the firm's assets.

Forward Contracts

A **forward contract** is a contract between two parties—a buyer and a seller—to purchase or sell something at a later date at a price agreed upon today. A forward contract sounds a lot like an option, but an option carries the right, not the obligation, to go through with the transaction. If the price of the underlying good changes, the option holder may decide to forgo buying or selling at the fixed price. On the other hand, the two parties in a forward contract incur the obligation to ultimately buy and sell the good.

Although forward markets have existed in this country for a long time, they are somewhat less familiar. Unlike options markets, they have no physical facilities for trading; there is no building or formal corporate body organized as the market. They trade strictly in an over-the-counter market consisting of direct communications among major financial institutions.

Forward markets for foreign exchange have existed for many years. With the rapid growth of derivative markets, we have seen an explosion of growth in forward markets for other instruments. It is now just as easy to enter into forward contracts for a stock index or oil as it was formerly to trade foreign currencies. Forward contracts are also extremely useful in that they facilitate the understanding of futures contracts.

Futures Contracts

A **futures contract** is also a contract between two parties—a buyer and a seller — to buy or sell something at a future date at a price agreed upon today. The contract trades on a futures exchange and is subject to a daily settlement procedure. Futures contracts evolved out of forward contracts and possess many of the same characteristics. In essence, they are like liquid forward contracts. Unlike forward contracts, however, futures contracts trade on organized exchanges, called **futures markets.** For example, the buyer of a futures contract, who has the obligation to buy the good at the later date, can sell the contract in the futures market, which relieves him or her of the obligation to purchase the good. Likewise, the seller of the futures contract, who is obligated to sell the good at the later date, can buy the contract back in the futures market, relieving him or her of the obligation to sell the good.

Futures contracts also differ from forward contracts in that they are subject to a daily settlement procedure. In the daily settlement, investors who incur losses pay them every day to investors who make profits. We shall learn more about this in Chapter 8.