OPTIONS AND FINANCIAL FUTURES

VALUATION AND USES

DAVID A. DUBOFSKY

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Texas A & M University

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DAVID A. DUBOFSKY is an Associate Professor of Finance at Texas A&M University. He earned a Bachelors of Chemical Engineering degree from the City College of New York, an M.B.A. from the University of Houston, and a Ph.D. in Finance from the University of Washington. He has published in such leading academic journals as the *Journal of Finance*; the *Journal of Money, Credit, and Banking*; the *Journal of Banking and Finance*; the *Journal of Futures Markets*; and the *Southern Economic Journal*. Dr. Dubofsky teaches courses in speculative markets, investments, and corporate finance.

To My Parents,
Harry and Celia,
and My Wife, Paulette

PREFACE

This book is an introduction to how option prices and financial futures prices are set in competitive markets. The book can be used in either junior/senior undergraduate courses or masters (M.B.A. / M.S.) level courses. I have written the book under the assumption that the student has had one introductory course in finance. The student should be familiar with such concepts as interest rates, what stocks and bonds are, the time value of money, elementary economics concepts such as supply and demand, and elementary probability concepts such as expected value and variance/standard deviation. I have kept the level of mathematics down; calculus is used sparingly, and almost always only for notational simplicity. Unavoidably, however, there is a great deal of algebraic manipulation, so students should be skilled at solving simple equations.

As stated above, the primary goal of this book is to explain how option prices and futures prices are derived in competitive markets. The book stresses that *arbitrage* is the driving force that sets these prices. Arbitrage is a trading activity that allows traders to risklessly earn cash profits with no cost. Arbitrage should not exist in a well-functioning market. Therefore, many of this book's pricing principles are derived on the basis that if the pricing principle did *not* hold, then arbitrage would exist. In equilibrium there is no excess supply or demand for the asset, so there are no arbitrage opportunities.

In practice, however, our markets are not so efficient. Some arbitrage opportunities do exist for those with substantial amounts of capital and those who can trade very quickly with very low transaction costs. Recently, a student in one of my classes asked a bond portfolio manager who uses interest rate futures whether he practiced arbitrage. The manager responded that he could not, because his futures commissions were $7 per contract (round turn), whereas those who arbitraged paid commissions of $1 per contract! Throughout the book, the student is reminded that arbitrage opportunities frequently present themselves, but the profits are small and are only for those who can act fast and trade with low costs. I also stress that the disequilibrium that creates an arbitrage opportunity will be

quickly corrected by arbitrageurs' actions. Buying an underpriced asset causes its price to rise, and selling an equivalent asset at a higher price results in a price decline. The repricing of the two assets should occur very rapidly, until the prices are equal and arbitrage is no longer possible. Thus, arbitrage serves the useful purpose of correcting mispriced assets.

This book focuses on arbitrage and valuation. Understanding how to price options and futures is important not only for trading these contracts, but also for understanding and valuing many situations that are faced in everyday business life. Firms regularly face situations in which they have the right to perform some task in the future (they own an option), or they have the obligation to perform some task in the future if someone else wants them to (they are short an option), or they have both the right and obligation to perform some task in the future (they are either long or short a forward/futures contract). Firms must be prepared to determine the values of these situations.

I believe that only by understanding how option and futures prices are set in well-functioning markets will you find it easy to use options and futures to control risk. This is the second goal of the book. Perhaps the primary justification for the existence of option and futures markets is that they allow the users to create risk and return patterns that match up with their levels of risk aversion and expectations, at low cost. We will discuss how options and futures can be used in order to hedge risks (lock in prices), and how to create insured situations (pay a price guaranteed to be below some specified maximum, or receive a price guaranteed to be above some specified minimum).

This book will not tell you how to get rich unless you have a method of accurately predicting the future more than 50 percent of the time, in which case options and futures can be used to speculate on your beliefs. The profits that you earn will be many times greater than if you actually bought the underlying asset in the cash market. For example, suppose you have developed a model that predicts that stock prices are about to rise. Buying call options on the stock market or stock index futures is likely to be the most efficient method of speculating on this prediction. This book will explain why but will not offer you models of predicting the future.

ORGANIZATION AND CONTENT

Part I of the book deals with options. Part II is concerned primarily with financial futures. I believe the book is sufficiently flexible that a user who prefers to cover futures first can start with Chapter 1, proceed to Chapters 11–18 in Part II, and then return to Chapters 2–10. Chapter 19 covers concepts drawn from several chapters; students will understand varying amounts of Chapter 19, depending on when it has been assigned during the semester.

Chapter 1 introduces options and futures contracts, explains why it is important to learn about them, and outlines their history. Chapter 2 is an introduction to options and option markets. It includes a great deal of jargon that is likely to be

new to the student. Some elementary principles of pricing are presented. Chapter 3 covers option strategies and their profit diagrams. Chapters 4 and 5 derive several restrictions on option prices. These boundaries must exist, or there will be opportunities for arbitrage. These chapters also contain important discussion of when American call and put owners will exercise early.

Chapter 6 covers the binomial option pricing model (BOPM) in great detail. I believe mastering the BOPM is extremely important because many option contracts and situations are so complicated that they cannot be easily valued in any way except by using the BOPM. Therefore, I cover the one-period and multi-period BOPM for calls. Then I demonstrate how both European and American calls are priced using the BOPM, when the underlying asset pays dividends. The BOPMs for European and American puts are derived. The chapter closes with a demonstration of portfolio insurance when the underlying asset follows a two-state (binomial) process.

Chapter 7 is primarily concerned with the Black and Scholes option pricing model. Chapter 8 delves into delta and delta hedging in greater depth. Chapter 9 covers index options, and Chapter 10 presents several applications of option pricing theory to corporate securities and situations.

Part II of the book begins with an introduction to futures contracts and markets in Chapter 11. Chapter 12 contains a general explanation of how futures prices are determined by the cost-of-carry pricing model. Chapter 13 is a general presentation of hedging theory using futures. Chapters 14, 16, 17, and 18 specifically apply the pricing and hedging principles of Chapters 12 and 13 to stock index futures, short-term interest rate futures (T-Bills and Eurodollars), long-term interest rate futures (primarily T-Bonds), and foreign exchange futures, respectively. Each of these contract groups is sufficiently different to warrant a separate chapter. Chapter 15 covers several subjects on debt instruments; the instructor may wish to assign section II of this chapter when covering short-term interest rate futures and sections I and III when covering long-term interest rate futures. Finally, Chapter 19 discusses several contracts, including futures options, options on cash debt instruments and interest rates, options on spot foreign exchange, and swaps.

There are examples throughout the text. The Instructor's Manual provides solutions to end-of-chapter questions and problems. A floppy disk provides several computer programs that can be used to aid the instructor and student in many ways. You can check problem solutions and, if necessary, determine where errors were made. Several properties of options can be illustrated using the computer programs. Some instructors may wish to spend less time performing laborious hand calculations, and the computer programs will facilitate this. For example, after you have covered the simple one-period BOPM by hand, most features of other binomial models can be illustrated using the computer programs. Similarly, some instructors may not wish to cover the intricate details of how to find the implied repo rate of T-Bond futures contracts; the computer program will compute these values, and the instructor can instead spend time on the intuition of what the implied repo rate actually is. Some instructors may wish to use the programs merely as a way to give students practice in using spreadsheets.

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I also thank Suzanne BeDell, Ken MacLeod, and Peitr Bohen of McGraw-Hill for applying the proper amount of pressure that prodded me along in this venture. Most of all, I thank Paulette for making many sacrifices during the several years that it took to write this book.

David A. Dubofsky

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