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# Derivatives Essentials

*An Introduction to Forwards, Futures,  
Options, and Swaps*

ARON GOTTESMAN

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# Preface

**T**his book provides an in-depth introduction to derivative securities. A derivative security is an agreement between two counterparties whose payoff depends on the value of an underlying asset. There is extensive interest in derivative securities due to their usefulness as tools through which investors can monetize views and transform exposures. Yet many that pursue an understanding of derivative securities can be frustrated with educational material that assumes the learner has sophisticated quantitative skills. Further, those with sophisticated quantitative skills can be frustrated with educational material that derives equations with little insight into the economic nature of derivative securities products and strategies.

This book focuses on helping you develop a meaningful understanding of derivative securities products and strategies and how to communicate your understanding both conceptually as well as through equations. You will learn about each product and strategy and the reasons for investing in them. You will learn about quantitative pricing and valuation models and will develop a deep understanding as to *why* the models represent price and value. You will learn of the great importance of the sensitivity measures known as the “Greeks” and learn how to use them to understand and characterize products and strategies.

Quantitative modeling is an important element of derivative securities, and this book will present quantitative models. However, this book does not assume that you have sophisticated quantitative or finance skills beyond the ability to add, subtract, multiply, divide, raise to a power, and rudimentary familiarity with time value of money concepts. Any other quantitative concept that is required to understand the material in this book will be introduced before it is required. Further, this book does not intend to provide comprehensive mathematical derivations nor provide quantitative overviews of each of the myriad of derivative securities variations in existence. Instead, the quantitative analysis in this book focuses on several key products through which we will explore conceptual and quantitative insights that are broadly applicable to other products and, most importantly, enable you to verbally communicate a deep understanding of products and strategies.

There are five parts to this book:

- Part One: Introduction to Forwards, Futures, and Options (Chapters 1–3)
- Part Two: Pricing and Valuation (Chapters 4–7)
- Part Three: The Greeks (Chapters 8–10)
- Part Four: Trading Strategies (Chapters 11–13)
- Part Five: Swaps (Chapters 14–15)

Part One introduces forwards, futures, and options. Forwards and futures are agreements that obligate counterparties to transact in the future. Options are agreements that provide one of the counterparties a right, and not an obligation, to transact in the future. In Part One you will learn about the key characteristics of forwards, futures, and options and each position's cash flows, payoffs, and P&L (profit and loss). You will also learn why forwards, futures, and options are described as zero-sum games and the concepts of moneyness and counterparty credit risk.

Part Two explores pricing and valuation of forwards and options. In Part Two you will learn to distinguish between price and value and explore models of price and value for each position, including the Black-Scholes and binomial option pricing models. You will also learn about the assumptions that these models make, risk-neutral valuation, and why the models represent price and value. You will also be introduced to the concepts of implied volatility and volatility surfaces.

Part Three explores the “Greeks,” which are measures of product and strategy sensitivity to change in the determinants of their value. In Part Three you will learn how to define, calculate, and interpret the Greeks and why they can be inaccurate. You will also develop a deep understanding of how the Greeks can be used to understand and describe sensitivity; why a given Greek will be positive, negative, or zero; and why its magnitude can change.

Part Four explores trading strategies. In Part Four you will learn how to describe and implement price and volatility trading strategies, create synthetic positions, and implement protective, yield enhancing, and spread trading strategies. The trading strategies that will be explored in Part Four include straddles, strangles, protective puts, covered calls, collars, bull spreads, bear spreads, risk reversals, butterfly spreads, and condor spreads, among others. You will also learn advanced concepts related to moneyness and put-call parity.

Part Five introduces swaps. A swap is an exchange of cash flows between two counterparties over a number of periods of time. In an interest rate swap the counterparties exchange fixed and floating interest rates. In a credit default swap periodic payments of spread are exchanged for a payment contingent on a credit event. In a cross-currency swap the counterparties

exchange interest payments in different currencies. In Part Five you will learn about the key characteristics of these swaps, their sensitivities and cash flows, and how they can be used to transform exposures.

Most of the chapters in this book build on the material in previous chapters. It is therefore important that you truly understand each chapter before advancing to the next. To allow you to test your understanding, there are more than 650 *Knowledge check* questions throughout the book, the solutions to which are provided in the appendix. The *Knowledge check* questions can be used to ensure absorption of the material both when you learn the material for the first time and also when you review.

I hope this book provides you with a deep understanding of derivative securities and an enjoyable and valuable learning experience!

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# One

## Introduction to Forwards, Futures, and Options





# Forwards and Futures

## INTRODUCTION

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A derivative security is an agreement between two counterparties whose payoff depends on the value of an underlying asset. In this chapter we will explore agreements that obligate counterparties to transact in the future, known as forward contracts and futures contracts.

After you read this chapter you will be able to

- Describe the key characteristics of a forward.
- Define and contrast the concepts of payoff and P&L.
- Describe a forward's cash flows, payoff, and P&L.
- Understand how equations and P&L diagrams can be used to describe a forward's cash flows.
- Understand when forwards earn profits, suffer losses, and break even.
- Explain why forwards are zero-sum games.
- Define counterparty credit risk and understand mechanisms through which it is managed and minimized.
- Describe futures contracts.
- Compare and contrast forwards and futures.

## 1.1 FORWARD CONTRACT CHARACTERISTICS

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A forward contract is an agreement between two counterparties that obligates them to transact in the future. The key characteristics of a forward are as follows:

- One of the counterparties is referred to as the “long position” or “long forward,” and the other counterparty is referred to as the “short position” or “short forward.”
- The long forward is obligated to purchase an asset from the short forward at a future point in time. The short forward is obligated to sell the asset.