CHAPTER

1 DERIVATIVE MARKETS AND INSTRUMENTS

LEARNING OUTCOMES

After completing this chapter, you will be able to do the following:

- Define the concept of a derivative.
- Describe the differences between exchange-traded and over-the-counter derivatives.
- Define a forward commitment and identify the different types of forward commitments.
- Describe the basic characteristics of forward contracts, futures contracts, and swaps.
- Define a contingent claim and identify the different types of contingent claims.
- Describe the basic characteristics of options and distinguish between an option to buy and an option to sell.
- Discuss the different ways to measure the size of the global derivatives market.
- Identify the purposes and criticisms of derivative markets.
- Explain the concept of arbitrage and the role it plays in determining prices and in promoting market efficiency.

1 INTRODUCTION

The concept of risk is at the heart of investment management. Financial analysts and portfolio managers continually identify, measure, and manage risk. In a simple world where only stocks and bonds exist, the only risks are the fluctuations associated with market values and the potential for a creditor to default. Measuring risk often takes the form of standard deviations, betas, and probabilities of default. In the above simple setting, managing risk is limited to engaging in stock and bond transactions that reduce or increase risk. For example, a portfolio manager may hold a combination of a risky stock portfolio and a risk-free bond, with the relative allocations determined by the investor's tolerance for risk. If for some reason the manager desires a lower level of risk, the only transactions available to adjust the risk downward are to reduce the allocation to the risky stock portfolio and increase the allocation to the risk-free bond.

But we do not live in a simple world of only stocks and bonds, and in fact investors can adjust the level of risk in a variety of ways. For example, one way to reduce risk is to use insurance, which can be described as the act of paying someone to assume a risk for

you. The financial markets have created their own way of offering insurance against financial loss in the form of contracts called **derivatives**. *A derivative is a financial instrument that offers a return based on the return of some other underlying asset.* In this sense, its return is *derived* from another instrument—hence, the name.

As the definition states, a derivative's performance is based on the performance of an underlying asset. This underlying asset is often referred to simply as the **underlying**.[1] It trades in a market in which buyers and sellers meet and decide on a price; the seller then delivers the asset to the buyer and receives payment. The price for immediate purchase of the underlying asset is called the **cash price** or **spot price** (in this book, we will use the latter term). A derivative also has a defined and limited life: A derivative contract initiates on a certain date and terminates on a later date. Often the derivative's payoff is determined and/or made on the expiration date, although that is not always the case. In accordance with the usual rules of law, a derivative contract is an agreement between two parties in which each does something for the other. In some cases, as in the simple insurance analogy, a derivative contract involves one party paying the other some money and receiving coverage against potential losses. In other cases, the parties simply agree that each will do something for the other at a later date. In other words, no money need change hands up front.

We have alluded to several general characteristics of derivative contracts. Let us now turn to the specific types of derivatives that we will cover in this book.

2 TYPES OF DERIVATIVES

In this section, we take a brief look at the different types of derivative contracts. This brief treatment serves only as a short introduction to familiarize you with the general ideas behind the contracts. We shall examine these derivatives in considerable detail in later chapters.

Let us start by noting that derivative contracts are created on and traded in two distinct but related types of markets: exchange traded and over the counter. Exchange-traded contracts have standard terms and features and are traded on an organized derivatives trading facility, usually referred to as a futures exchange or an options exchange. Over-the-counter contracts are any transactions created by two parties anywhere else. We shall examine the other distinctive features of these two types of contracts as we proceed.

Derivative contracts can be classified into two general categories: forward commitments and contingent claims. In the following section, we examine forward commitments, which are contracts in which the two parties enter into an agreement to engage in a transaction at a later date at a price established at the start. Within the category of forward commitments, two major classifications exist: exchanged-traded contracts, specifically futures, and over-the-counter contracts, which consist of forward contracts and swaps.

2.1 Forward Commitments

The **forward contract** is an agreement between two parties in which one party, the buyer, agrees to buy from the other party, the seller, an underlying asset at a future date at a price established at the start. The parties to the transaction specify the forward contract's terms and conditions, such as when and where delivery will take place and the precise identity of the underlying. In this sense, the contract is said to be *customized.* Each party is subject to the possibility that the other party will default.

[1] On behalf of the financial world, we apologize to all English teachers. "Underlying" is not a noun, but in the world of derivatives it is commonly used as such. To be consistent with that terminology, we use it in that manner here.

Many simple, everyday transactions are forms of forward commitments. For example, when you order a pizza for delivery to your home, you are entering into an agreement for a transaction to take place later ("30 minutes or less," as some advertise) at a price agreed on at the outset. Although default is not likely, it could occur—for instance, if the party ordering the pizza decided to go out to eat, leaving the delivery person wondering where the customer went. Or perhaps the delivery person had a wreck on the way to delivery and the pizza was destroyed. But such events are extremely rare.

Forward contracts in the financial world take place in a large and private market consisting of banks, investment banking firms, governments, and corporations. These contracts call for the purchase and sale of an underlying asset at a later date. The underlying asset could be a security (i.e., a stock or bond), a foreign currency, a commodity, or combinations thereof, or sometimes an interest rate. In the case of an interest rate, the contract is not on a bond from which the interest rate is derived but rather on the interest rate itself. Such a contract calls for the exchange of a single interest payment for another at a later date, where at least one of the payments is determined at the later date.[2]

As an example of someone who might use a forward contract in the financial world, consider a pension fund manager. The manager, anticipating a future inflow of cash, could engage in a forward contract to purchase a portfolio equivalent to the S&P 500 at a future date—timed to coincide with the future cash inflow date—at a price agreed on at the start. When that date arrives, the cash is received and used to settle the obligation on the forward contract.[3] In this manner, the pension fund manager commits to the position in the S&P 500 without having to worry about the risk that the market will rise during that period. Other common forward contracts include commitments to buy and sell a foreign currency or a commodity at a future date, locking in the exchange rate or commodity price at the start.

The forward market is a private and largely unregulated market. Any transaction involving a commitment between two parties for the future purchase/sale of an asset is a forward contract. Although pizza deliveries are generally not considered forward contracts, similar transactions occur commonly in the financial world. Yet we cannot simply pick up *The Wall Street Journal* or *The Financial Times* and read about them or determine how many contracts were created the previous day.[4] They are private transactions for a reason: The parties want to keep them private and want little government interference. This need for privacy and the absence of regulation does not imply anything illegal or corrupt but simply reflects a desire to maintain a prudent level of business secrecy.

Recall that we described a forward contract as an agreement between two parties in which one party, the buyer, agrees to buy from the other party, the seller, an underlying asset at a future date at a price agreed upon at the start. A **futures contract** is a variation of a forward contract that has essentially the same basic definition but some additional features that clearly distinguish it from a forward contract. For one, a futures contract is not a private and customized transaction. Instead, it is a public, standardized transaction that takes place on a futures exchange. A futures exchange, like a stock exchange, is an organization that provides a facility for engaging in futures transactions and establishes a mech-

[2] These instruments are called forward rate agreements and will be studied in detail in Chapter 2.

[3] The settling of the forward contract can occur through delivery, in which case the buyer pays the agreed-upon price and receives the asset from the seller, or through an equivalent cash settlement. In the latter case, the seller pays the buyer the difference between the market price and the agreed-upon price if the market price is higher. The buyer pays the seller the difference between the agreed-upon price and the market price if the agreed-upon price is higher.

[4] In Section 4 of this chapter, we will look at some ways to measure the amount of this type of trading.

anism through which parties can buy and sell these contracts. The contracts are standardized, which means that the exchange determines the expiration dates, the underlying, how many units of the underlying are included in one contract, and various other terms and conditions.

Probably the most important distinction between a futures contract and a forward contract, however, lies in the default risk associated with the contracts. As noted above, in a forward contract, the risk of default is a concern. Specifically, the party with a loss on the contract could default. Although the legal consequences of default are severe, parties nonetheless sometimes fall into financial trouble and are forced to default. For that reason, only solid, creditworthy parties can generally engage in forward contracts. In a futures contract, however, the futures exchange guarantees to each party that if the other fails to pay, the exchange will pay. In fact, the exchange actually writes itself into the middle of the contract so that each party effectively has a contract with the exchange and not with the other party. The exchange collects payment from one party and disburses payment to the other.

The futures exchange implements this performance guarantee through an organization called the clearinghouse. For some futures exchanges, the clearinghouse is a separate corporate entity. For others, it is a division or subsidiary of the exchange. In either case, however, the clearinghouse protects itself by requiring that the parties settle their gains and losses to the exchange on a daily basis. This process, referred to as the daily settlement or marking to market, is a critical distinction between futures and forward contracts. With futures contracts, profits and losses are charged and credited to participants' accounts each day. This practice prevents losses from accumulating without being collected. For forward contracts, losses accumulate until the end of the contract.[5]

One should not get the impression that forward contracts are rife with credit losses and futures contracts never involve default. Credit losses on forward contracts are extremely rare, owing to the excellent risk management practices of participants. In the case of futures contracts, parties do default on occasion. In fact, it is likely that there are more defaults on futures contracts than on forward contracts.[6] Nonetheless, the exchange guarantee has never failed for the party on the other side of the transaction. Although the possibility of the clearinghouse defaulting does exist, the probability of such a default happening is extremely small. Thus, we can generally assume that futures contracts are default-free. In contrast, the possibility of default, although relatively small, exists for forward contracts.

Another important distinction between forward contracts and futures contracts lies in the ability to engage in offsetting transactions. Forward contracts are generally designed to be held until expiration. It is possible, however, for a party to engage in the opposite transaction prior to expiration. For example, a party might commit to purchase one million euros at a future date at an exchange rate of $0.85/€. Suppose that later the euro has a for-

[5] Although this process of losses accumulating on forward contracts until the expiration day is the standard format for a contract, modern risk management procedures include the possibility of forcing a party in debt to periodically pay losses accrued prior to expiration. In addition, a variety of risk-reducing techniques, such as the use of collateral, are used to mitigate the risk of loss. We discuss these points in more detail in Chapters 2 and 9.

[6] Defaults are more likely for futures contracts than for forward contracts because participants in the forward markets must meet higher creditworthiness standards than those in the futures markets. Indeed, many individuals participate in the futures markets; forward market participants are usually large, creditworthy companies. But the forward markets have no guarantor of performance, while the futures markets do. Therefore, participants in the forward markets have incurred credit losses in the past, while participants in the futures markets have not.

ward price of \$0.90/€. The party might then choose to engage in a new forward contract to sell the euro at the new price of \$0.90/€. The party then has a commitment to buy the euro at \$0.85 and sell it at \$0.90. The risk associated with changes in exchange rates is eliminated, but both transactions remain in place and are subject to default.[7]

In futures markets, the contracts have standardized terms and trade in a market that provides sufficient liquidity to permit the parties to enter the market and offset transactions previously created. The use of contracts with standardized terms results in relatively widespread acceptance of these terms as homogeneous agreed-upon standards for trading these contracts. For example, a U.S. Treasury bond futures contract covering \$100,000 face value of Treasury bonds, with an expiration date in March, June, September, or December, is a standard contract. In contrast, if a party wanted a contract covering \$120,000 of Treasury bonds, he would not find any such instrument in the futures markets and would have to create a nonstandard instrument in the forward market. The acceptance of standardized terms makes parties more willing to trade futures contracts. Consequently, futures markets offer the parties liquidity, which gives them a means of buying and selling the contracts. Because of this liquidity, a party can enter into a contract and later, before the contract expires, enter into the opposite transaction and offset the position, much the same way one might buy or sell a stock or bond and then reverse the transaction later. This reversal of a futures position completely eliminates any further financial consequences of the original transaction.[8]

A **swap** is a variation of a forward contract that is essentially equivalent to a series of forward contracts. Specifically, a swap is an agreement between two parties to exchange a series of future cash flows. Typically at least one of the two series of cash flows is determined by a later outcome. In other words, one party agrees to pay the other a series of cash flows whose value will be determined by the unknown future course of some underlying factor, such as an interest rate, exchange rate, stock price, or commodity price. The other party promises to make a series of payments that could also be determined by a second unknown factor or, alternatively, could be preset. We commonly refer to swap payments as being "fixed" or "floating" (sometimes "variable").

We noted that a forward contract is an agreement to buy or sell an underlying asset at a future date at a price agreed on today. A swap in which one party makes a single fixed payment and the other makes a single floating payment amounts to a forward contract. One party agrees to make known payments to the other and receive something unknown in return. This type of contract is like an agreement to buy at a future date, paying a fixed amount and receiving something of unknown future value. That the swap is a *series* of such payments distinguishes it from a forward contract, which is only a single payment.[9]

Swaps, like forward contracts, are private transactions and thus not subject to direct regulation.[10] Swaps are arguably the most successful of all derivative transactions. Probably the most common use of a swap is a situation in which a corporation, currently

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[7] It is possible for the party engaging in the first transaction to engage in the second transaction with the same party. The two parties agree to cancel their transactions, settling the difference in value in cash and thereby eliminating the risk associated with exchange rates as well as the possibility of default.

[8] A common misconception is that, as a result of their standardized terms, futures contracts are liquid but nonstandardized forward contracts are illiquid. This is not always the case; many futures contracts have low liquidity and many forward contracts have high liquidity.

[9] A few other distinctions exist between swaps and forward contracts, such as the fact that swaps can involve both parties paying a variable amount.

[10] Like all over-the-counter derivatives transactions, swaps are subject to indirect regulatory oversight in that the companies using them could be regulated by securities or banking authorities. In addition, swaps, like all contracts, are subject to normal contract and civil law.

borrowing at a floating rate, enters into a swap that commits it to making a series of interest payments to the swap counterparty at a fixed rate, while receiving payments from the swap counterparty at a rate related to the floating rate at which it is making its loan payments. The floating components cancel, resulting in the effective conversion of the original floating-rate loan to a fixed-rate loan.

Forward commitments (whether forwards, futures, or swaps) are firm and binding agreements to engage in a transaction at a future date. They obligate each party to complete the transaction, or alternatively, to offset the transaction by engaging in another transaction that settles each party's financial obligation to the other. Contingent claims, on the other hand, allow one party the flexibility to not engage in the future transaction, depending on market conditions.

2.2 Contingent Claims

Contingent claims are derivatives in which the payoffs occur if a specific event happens. We generally refer to these types of derivatives as options. Specifically, an **option** is a financial instrument that gives one party the right, but not the obligation, to buy or sell an underlying asset from or to another party at a fixed price over a specific period of time. An option that gives the right to buy is referred to as a call; an option that gives the right to sell is referred to as a put. The fixed price at which the underlying can be bought or sold is called the exercise price, strike price, striking price, or strike, and is determined at the outset of the transaction. In this book, we refer to it as the exercise price, and the action of buying or selling the underlying at the exercise price is called exercising the option. The holder of the option has the right to exercise it and will do so if conditions are advantageous; otherwise, the option will expire unexercised. Thus, the payoff of the option is contingent on an event taking place, so options are sometimes referred to as contingent claims.

In contrast to participating in a forward or futures contract, which represents a *commitment* to buy or sell, owning an option represents the *right* to buy or sell. To acquire this right, the buyer of the option must pay a price at the start to the option seller. This price is called the option premium or sometimes just the option price. In this book, we usually refer to it as the option price.

Because the option buyer has the right to buy or sell an asset, the seller of the option has the potential commitment to sell or buy this asset. If the option buyer has the right to buy, the option seller may be obligated to sell. If the option buyer has the right to sell, the option seller may be obligated to buy. As noted above, the option seller receives the amount of the option price from the option buyer for his willingness to bear this risk.

An important distinction we made between forward and futures contracts was that the former are customized private transactions between two parties without a guarantee against losses from default. The latter are standardized contracts that take place on futures exchanges and are guaranteed by the exchange against losses from default. For options, both types of contracts—over-the-counter customized and exchange-listed standardized—exist. In other words, the buyer and seller of an option can arrange their own terms and create an option contract. Alternatively, the buyer and seller can meet directly, or through their brokers, on an options exchange and trade standardized options. In the case of customized options, the buyer is subject to the possibility of the seller defaulting when and if the buyer decides to exercise the option. Because the option buyer is not obligated to do anything beyond paying the original price, the seller of any type of option is not subject to the buyer defaulting. In the case of a standardized option, the buyer does not face the risk of the seller defaulting. The exchange, through its clearinghouse, guarantees the seller's performance to the buyer.

A variety of other instruments contain options and thus are forms of contingent claims. For instance, many corporations issue convertible bonds offering the holder an op-

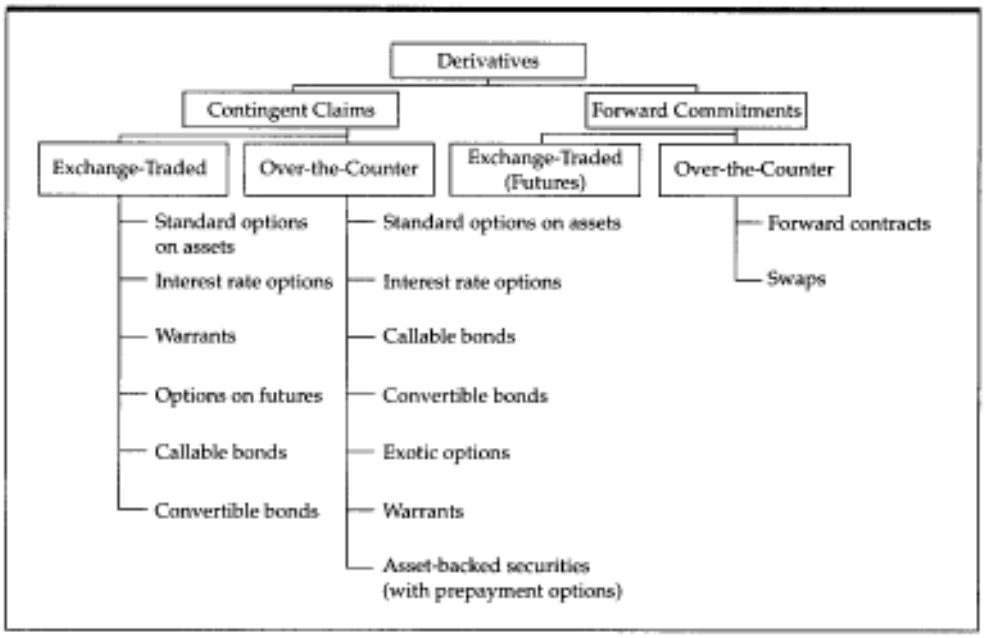
tionlike feature that enables the holder to participate in gains on the market price of the corporation's stock without having to participate in losses on the stock. Callable bonds are another example of a common financial instrument that contains an option, in this case the option of the issuer to pay off the bond before its maturity. Options themselves are often characterized in terms of standard or fairly basic options and more advanced options, often referred to as exotic options. There are also options that are not even based on assets but rather on futures contracts or other derivatives. A very widely used group of options is based on interest rates.

Another common type of option is contained in asset-backed securities. An asset-backed security is a claim on a pool of securities. The pool, which might be mortgages, loans, or bonds, is a portfolio assembled by a financial institution that then sells claims on the portfolio. Often, the borrowers who issued the mortgages, loans, or bonds have the right to pay off their debts early, and many choose to do so when interest rates fall significantly. They then refinance their loans by taking out a new loan at a lower interest rate. This right, called a prepayment feature, is a valuable option owned by the borrower. Holders of asset-backed securities bear the risk associated with prepayment options and hence are sellers of those options. The holders, or option sellers, receive a higher promised yield on their bond investment than they would have received on an otherwise equivalent bond without the option.

With an understanding of derivatives, there are no limits to the types of financial instruments that can be constructed, analyzed, and applied to achieve investment objectives. What you learn from this book and the CFA Program will help you recognize and understand the variety of derivatives that appear in many forms in the financial world.

Exhibit 1-1 presents a classification of the types of derivative contracts as we have described them. Note that we have partitioned derivatives into those that are exchange-traded and those that trade in the over-the-counter market. The exhibit also notes some other categories not specifically mentioned above. These instruments are included for completeness, but they are relatively advanced and not covered in this first chapter.

EXHIBIT 1-1 A Classification of Derivatives



We have now looked at the basic characteristics of derivative contracts. In order to better understand and appreciate derivatives, we should take a quick look at where they came from and where they are now. Accordingly, we take a brief look at the history and current state of derivative markets.

3 DERIVATIVE MARKETS: PAST AND PRESENT

Derivative markets have an exciting and colorful history. Examining that history gives insights that help us understand the structure of these markets as they exist today.

The basic characteristics of derivative contracts can be found throughout the history of humankind. Agreements to engage in a commercial transaction as well as agreements that provide the right to engage in a commercial transaction date back hundreds of years. In medieval times, contracts for the future delivery of an asset with the price fixed at the time of the contract initiation were frequent. Early indications of futures markets were seen in Japan many hundreds of years ago. The futures markets generally trace their roots, however, to the 1848 creation of the Chicago Board of Trade, the first organized futures market. Its origins resulted from the burgeoning grain markets in Chicago, which created a need for a farmer to secure a price at one point in time, store the grain, and deliver it at a later point in time. At around the same time, customized option transactions were being offered, including some by the well known financier Russell Sage, who found a clever way to offer combinations of customized options that replicated a loan at a rate that exceeded the maximum allowable rate under the then-existing usury laws.[11]

In the century that followed, the futures industry grew rapidly. Institutions such as the Chicago Board of Trade, the Chicago Mercantile Exchange, and later, the New York Mercantile Exchange and the Chicago Board Options Exchange became the primary forces in the global derivatives industry. These exchanges created and successfully marketed many innovative derivative contracts.[12] Although the first 100 years of futures exchanges were dominated by trading in futures on agricultural commodities, the 1970s saw the introduction of futures on financial instruments such as currencies, bonds, and stock indices. These "financial futures," as well as newly introduced options on individual stocks, currencies, bonds, and stock indices, ushered in a new era in which financial derivatives dominated agricultural derivatives—a situation that continues today. Although the commodity derivatives market includes very active contracts in oil and precious metals, financial derivatives have remained the primary force in the worldwide derivatives market.

Exchange-listed standardized derivatives, however, have hardly been the only instruments in the derivatives world. As noted, customized options have been around since at least the 19th century. The customized-options market flourished until the early 1970s, largely as a retail product. With the introduction of standardized options in 1973, however, the customized options market effectively died. But something else was going on at the time that would later revive this market. In the early 1970s, foreign exchange rates were deregulated and allowed to float freely. This deregulation led not only to the development of a futures, and later options, market for currencies but also to a market for customized forward contracts in foreign currencies. This market became known as the interbank

[11] Sage was perhaps the first options arbitrageur. Of course, usury laws are rare these days and most investors understand put–call parity, so do not expect to make any money copying Sage's scheme.

[12] It is probably also important to note that the futures and options exchanges have introduced many unsuccessful contracts as well.

EXHIBIT 1-2 Global Derivatives Exchanges

North America
American Stock Exchange
Bourse de Montreal
BrokerTec Futures Exchange
Chicago Board Options Exchange
Chicago Board of Trade
Chicago Mercantile Exchange
International Securities Exchange (New York)
Kansas City Board of Trade
Minneapolis Grain Exchange
New York Board of Trade
New York Mercantile Exchange
Pacific Exchange (San Francisco)
Philadelphia Stock Exchange
Winnipeg Commodity Exchange

Asia
Central Japan Commodity Exchange
Dalian Commodity Exchange
Hong Kong Exchanges & Clearing
Kansai Commodities Exchange (Osaka)
Korea Futures Exchange
Korea Stock Exchange
Malaysia Derivatives Exchange
New Zealand Futures & Options Exchange
Osaka Mercantile Exchange
Shanghai Futures Exchange
Singapore Commodity Exchange
Singapore Exchange
Tokyo Commodity Exchange
Tokyo Grain Exchange
Tokyo International Financial Futures Exchange
Tokyo Stock Exchange
Zhengzhou Commodity Exchange

Europe
Bolsa de Valores de Lisboa e Porto
Borsa Italiana
Budapest Commodity Exchange
Eurex Frankfurt
Eurex Zurich
Euronext Amsterdam
Euronext Brussels
Euronext Paris
FUTOP Market (Copenhagen)
Helsinki Exchanges Group
International Petroleum Exchange of London
London International Financial Futures and Options Exchange
London Metal Exchange
MEFF Renta Fija (Barcelona)
MEFF Renta Variable (Madrid)
OM London Exchange
OM Stockholm Exchange
Romanian Commodity Exchange
Sibiu Monetary–Financial and Commodities Exchange (Romania)
Tel Aviv Stock Exchange
Wiener Borse AG (Vienna)

South America
Bolsa de Mercadorias & Futuros (Sao Paulo)
Mercado a Termino de Buenos Aires
Santiago Stock Exchange

Africa
South African Futures Exchange

Australia
Australian Stock Exchange
Sydney Futures Exchange

Source: Futures [magazine] *2002 Sourcebook.*

market because it was largely operated within the global banking community, and it grew rapidly. Most importantly, it set the stage for the banking industry to engage in other customized derivative transactions.

Spurred by deregulation of their permitted activities during the 1980s, banks discovered that they could create derivatives of all forms and sell them to corporations and institutions that had risks that could best be managed with products specifically tailored for a given situation. These banks make markets in derivative products by assuming the risks

that the corporations want to eliminate. But banks are not in the business of assuming unwanted risks. They use their vast resources and global networks to transfer or lay off the risk elsewhere, often in the futures markets. If they successfully lay off these risks, they can profit by buying and selling the derivatives at a suitable bid–ask spread. In addition to banks, investment banking firms also engage in derivatives transactions of this sort. The commercial and investment banks that make markets in derivatives are called **derivatives dealers**. Buying and selling derivatives is a natural extension of the activity these banks normally undertake in financial markets. This market for customized derivatives is what we refer to as the over-the-counter derivatives market.

By the end of the 20th century, the derivatives market reached a mature stage, growing at only a slow pace but providing a steady offering of existing products and a continuing slate of new products. Derivatives exchanges underwent numerous changes, often spurred by growing competition from the over-the-counter market. Some merged; others that were formerly nonprofit corporations have since become profit making. Some derivatives exchanges have even experimented with offering somewhat customized transactions. Nearly all have lobbied heavily for a reduction in the level or structure of the regulations imposed on them. Some derivatives exchanges have altered the manner in which trading takes place, from the old system of face-to-face on a trading floor (in sections called pits) to off-floor electronic trading in which participants communicate through computer screens. This type of transacting, called electronic trading, has even been extended to the Internet and, not surprisingly, is called e-trading. Pit trading is still the primary format for derivatives exchanges in the United States, but electronic trading is clearly the wave of the future. As the dominant form of trading outside the United States, it will likely replace pit trading in the United States in coming years.

Exhibit 1-2 (on page 9) lists all global derivatives exchanges as of January 2002. Note that almost every country with a reasonably advanced financial market system has a derivatives exchange.

We cannot technically identify where over-the-counter derivatives markets exist. These types of transactions can conceivably occur anywhere two parties can agree to engage in a transaction. It is generally conceded, however, that London and New York are the primary markets for over-the-counter derivatives; considerable activity also takes place in Tokyo, Paris, Frankfurt, Chicago, Amsterdam, and many other major world cities.

Now we know where the derivative markets are, but are they big enough for us to care about? We examine this question in Section 4.

4 HOW BIG IS THE DERIVATIVES MARKET?

Good question. And the answer is: We really do not know. Because trading in exchange-listed contracts, such as futures and some options, is recorded, volume figures for those types of contracts are available. Exhibit 1-3 presents summary statistics for contract volume of global futures and options for 2000 and 2001. Note that in 2001, the largest category is equity indices. In 2000, the largest category was individual equities, followed by interest rates. In prior years, the largest category had been interest rates.

Currently, the United States accounts for approximately 35 percent of global futures and options volume. The largest exchange in the world, however, is the Korea Stock Exchange, which trades an exceptionally large volume of options on a Korean stock index. The second-largest exchange (and the largest exchange in terms of futures volume only) is the combined German–Swiss exchange called Eurex. The other largest exchanges (in order of 2001 volume) are the Chicago Mercantile Exchange, the Chicago Board of Trade, the London International Financial Futures and Options Exchange, the Paris Bourse, the

EXHIBIT 1-3 Global Exchange-Traded Futures and Options Contract Volume
(in millions of contracts)

Contract Type	2000	2001
Equity indices	674.8	1,470.3
Interest rates	844.3	1,216.1
Individual equities	969.7	1,112.7
Energy	154.8	166.9
Agricultural	185.7	156.5
Nonprecious metals	75.7	70.2
Currencies	47.0	49.2
Precious metals	36.2	39.1
Other	1.3	0.8
Overall Total	2,989.5	4,281.8

Source: Futures Industry (January/February 2002).

New York Mercantile Exchange, the Bolsa de Mercadorias & Futuros of Brazil, and the Chicago Board Options Exchange. All of these exchanges traded at least 70 million contracts in 2001.[13]

One important factor that must be considered, however, in looking at trading volume as a measure of activity is that the futures and options exchanges influence their own volume by designating a contract's size. For example, a standard option in the United States covers 100 shares of the underlying stock. If an investor takes a position in options on 1,000 shares of stock, the investor would trade 10 options. If the options exchange had designated that the contract size be 200 options, then the investor would trade only five contracts. Although there are often good reasons for setting a contract size at a certain level, volume comparisons must be taken with a degree of skepticism.[14]

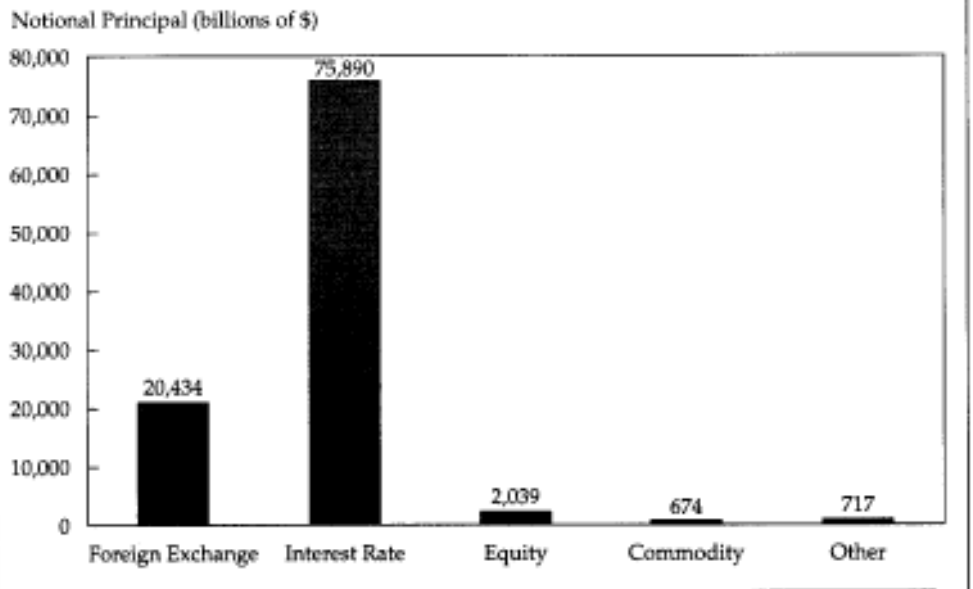
The over-the-counter derivatives market is much more difficult to measure. Because the transactions are private, unregulated, and can take place virtually anywhere two parties can enter into an agreement, no official tabulation exists that allows us to identify the size of the market. Information is available, however, from semiannual surveys conducted by the Bank for International Settlements (BIS) of Basel, Switzerland, an international organization of central banks. The BIS publishes this data in its semiannual report "Regular OTC Derivatives Market Statistics," available on its Web site at www.bis.org/publ/regpubl.htm.

Exhibit 1-4 presents two charts constructed from the 30 June 2001 BIS survey and shows figures for foreign exchange, interest rate, equity, and commodity derivatives

[13] *Futures Industry* (January/February 2002).

[14] For example, in 1999 the volume of Treasury bond futures on the Chicago Board of Trade was about 90 million contracts while the volume of Eurodollar futures on the Chicago Mercantile Exchange was about 93 million contracts. Consequently, at that time these two contracts appeared to have about the same amount of activity. But the Treasury bond contract covers Treasury bonds with a face value of $100,000 while the Eurodollar contract covers Eurodollars with a face value of $1,000,000. Thus, the Eurodollar futures market was arguably 10 times the size of the Treasury bond futures market. In 2002, about three Eurodollar futures contracts were traded for every Treasury bond futures contract traded.

EXHIBIT 1-4A Outstanding Notional Principal of Global Over-the-Counter Derivatives, 30 June 2001 (billions)



Source: Bank for International Settlements, www.bis.org/publ/regpubl.htm

transactions. The "other" category, however, does include transactions of these types and reflects the BIS's estimates of positions taken by parties that do not report in this survey. It is used primarily to obtain an estimate for the overall size of the market and is not broken down by category.

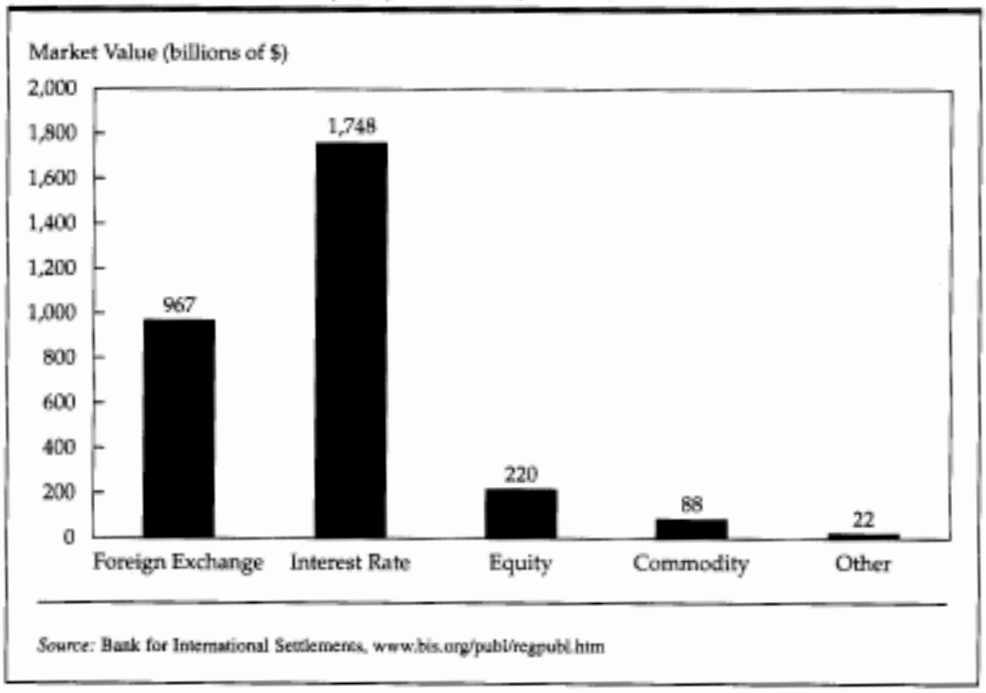
For over-the-counter derivatives, notional principal is the most widely used measure of market size. Notional principal measures the amount of the underlying asset covered by a derivative contract. For example, a swap involving interest payments on ¥500 million has a notional principal of ¥500 million. The actual payments made in the swap, however, are merely interest payments on ¥500 million and do not come close to ¥500 million.[15] Thus, although notional principal is a commonly used measure of the size of the market, it can give a misleading impression by suggesting that it reflects the amount of money involved.[16]

Nonetheless, we would be remiss if we failed to note the market size as measured by notional principal. Based on Exhibit 1-4A, the total notional principal summing over these

[15] In fact, the payments on a swap are even smaller than the interest payments on the notional principal. Swap interest payments usually equal only the difference between the interest payments owed by the two parties.

[16] The over-the-counter derivatives industry originally began the practice of measuring its size by notional principal. This was a deliberate tactic designed to make the industry look larger so it would be more noticed and viewed as a significant and legitimate force. As it turns out, this tactic backfired, resulting in fears that more money was involved and at risk of loss than really was. Calls for increased scrutiny of the industry by government authorities resulted in the industry backpedaling on its use of notional principal and focusing more on market value as a measure of its size. Nonetheless, notional principal continues to be used as one, if not the primary, measure of the industry's size.

EXHIBIT 1-4B Outstanding Market Value of Global Over-the-Counter Derivatives, 30 June 2001 (billions)



Source: Bank for International Settlements, www.bis.org/publ/regpubl.htm

five categories is almost $100 trillion. Also note that interest rate derivatives are the most widely used category by far.

Exhibit 1-4B gives another picture of the size of the market by indicating the market value of over-the-counter derivatives. Market value indicates the economic worth of a derivative contract and represents the amount of money that would change hands if these transactions were terminated at the time of the report. The total market value for all categories is about $3 trillion. Market value is a better indication of the size of the market because it more accurately represents the actual money involved. Nonetheless, market value is subject to greater errors in estimation and thus is a less reliable measure than notional principal.

Although it is impossible to determine where these contracts originate, dollar-denominated derivatives represented about 34 percent of the global interest rate derivatives market in 2001, with euro-denominated derivatives accounting for about 27 percent and yen-denominated derivatives representing 17 percent.

Whether notional principal or market value is used, it is clear that the derivatives industry is large by any standard. Derivatives are widely available in global asset markets, and consequently, understanding derivatives is essential to operating in these markets, whether one chooses to use them or not.

Because derivative markets have been created around the world, there must be a reason for their continued existence. Let us now look at why derivative markets exist.

5 THE PURPOSES OF DERIVATIVE MARKETS

Derivative markets serve a variety of purposes in global social and economic systems. One of the primary functions of futures markets is **price discovery**. Futures markets provide

valuable information about the prices of the underlying assets on which futures contracts are based. They provide this information in two ways. First, many of these assets are traded in geographically dispersed markets. Recall that the current price of the underlying asset is called the spot price. With geographically dispersed markets, many different spot prices could exist. In the futures markets, the price of the contract with the shortest time to expiration often serves as a proxy for the price of the underlying asset. Second, the prices of all futures contracts serve as prices that can be accepted by those who trade contracts in lieu of facing the risk of uncertain future prices. For example, a company that mines gold can hedge by selling a futures contract on gold expiring in two months, which locks in the price of gold two months later. In this manner, the two-month futures price substitutes for the uncertainty of the price of gold over the next two months.[17]

Futures contracts are not, however, the only derivatives that serve this purpose. In fact, forward contracts and swaps allow users to substitute a single locked-in price for the uncertainty of future spot prices and thereby permit the same form of price discovery as do futures.

Options work in a slightly different manner. They are used in a different form of hedging, one that permits the holder to protect against loss while allowing participation in gains if prices move favorably. Options do not so much reveal *prices* as they reveal *volatility*. As we shall see in Chapter 4, the volatility of the underlying asset is a critical factor in the pricing of options. It is possible, therefore, to infer what investors feel about volatility from the prices of options.

Perhaps the most important purpose of derivative markets is **risk management**. We define risk management as the process of identifying the desired level of risk, identifying the actual level of risk, and altering the latter to equal the former. Often this process is described as hedging, which generally refers to the reduction, and in some cases the elimination, of risk. On the other side is the process called speculation. Traditional discussions of derivatives refer to hedging and speculation as complementary activities. In general, hedgers seek to eliminate risk and need speculators to assume risk, but such is not always the case. Hedgers often trade with other hedgers, and speculators often trade with other speculators. All one needs to hedge or speculate is a party with opposite beliefs or opposite risk exposure. For example, a corporation that mines gold could hedge the future sale of gold by entering into a derivative transaction with a company that manufactures jewelry. Both of these companies are hedgers, seeking to avoid the uncertainty of future gold prices by locking in a price for a future transaction. The mining corporation has concerns about a price decrease, and the jewelry manufacturer is worried about a price increase.

An unfortunate consequence of the use of the terms "hedging" and "speculating" is that hedgers are somehow seen as on the high moral ground and speculators are sometimes seen as evil—a distortion of the role of speculators. In fact, there need be very little difference between hedgers and speculators. To restate an example we used when discussing swaps, consider a corporation that currently borrows at a floating rate. A common response to a fear of rising interest rates is for the corporation to use an interest rate swap in which it will make payments at a fixed rate and receive payments at a floating rate. The floating-rate payments it receives from the swap offset the floating-rate payments on the loan, thereby effectively converting the loan to a fixed-rate loan. The company is now borrowing at a fixed rate and, in the eyes of many, hedging.

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[17] Some people view futures prices as revealing expectations of future spot prices of the underlying asset, and in that sense, leading to price discovery. This view, however, is incorrect. Futures prices are not necessarily expectations of future spot prices. As we discussed above, they allow a substitution of the futures price for the uncertainty of future spot prices of the asset. In that sense they permit the acceptance of a sure price and the avoidance of risk.

But is the company really hedging? Or is it simply making a bet that interest rates will increase? If interest rates decrease, the company will be losing money in the sense of the lost opportunity to borrow at a lower rate. From a budgeting and cash flow standpoint, however, its fixed interest payments are set in stone. Moreover, the market value of a fixed-rate loan is considerably more volatile than that of a floating-rate loan. Thus, our "hedging" corporation can be viewed as taking more risk than it originally had.

The more modern view of the reason for using derivatives does not refer to hedging or speculation. Although we shall sometimes use those terms, we shall use them carefully and make our intentions clear. In the grander scheme of things, derivatives are tools that enable companies to more easily practice risk management. In the context of our corporation borrowing at the floating rate, it made a conscious decision to borrow at a fixed rate. Engaging in the swap is simply an activity designed to align its risk with the risk it wants, given its outlook for interest rates. Whether one calls this activity hedging or speculation is not even very important. The company is simply managing risk.

Derivative markets serve several other useful purposes. As we show later when exploring the pricing of derivative contracts, they improve market efficiency for the underlying assets. Efficient markets are fair and competitive and do not allow one party to easily take money from another. As a simple example, we shall learn in Chapter 3 that buying a stock index fund can be replicated by buying a futures on the fund and investing in risk-free bonds the money that otherwise would have been spent on the fund. In other words, the fund and the combination of the futures and risk-free bond will have the same performance. But if the fund costs more than the combination of the futures and risk-free bond, investors have the opportunity to avoid the overpriced fund and take the combination.[18] This decreased demand for the fund will lower its price. The benefits to investors who do not even use derivatives should be clear: They can now invest in the fund at a more attractive price, because the derivatives market forced the price back to its appropriate level.

Derivative markets are also characterized by relatively low transaction costs. For example, the cost of investing in a stock index portfolio is as much as 20 times the cost of buying a futures contract on the index and a risk-free bond as described above. One might reasonably ask why derivatives are so much less expensive in terms of transaction costs. The answer is that derivatives are designed to provide a means of managing risk. As we have previously described, they serve as a form of insurance. Insurance cannot be a viable product if its cost is too high relative to the value of the insured asset. In other words, derivatives must have low transaction costs; otherwise, they would not exist.

It would be remiss to overlook the fact that derivative markets have been subject to many criticisms. We next present some of these complaints and the reasons behind them.

6 CRITICISMS OF DERIVATIVE MARKETS

Derivatives have been highly controversial for a number of reasons. For one, they are very complex. Much of the criticism has stemmed from a failure to understand derivatives. When derivatives fail to do their job, it is often the derivatives themselves, rather than the users of derivatives, that take the blame. Yet, in many cases, the critics of derivatives simply do not understand them well enough. As described in Section 2, when homeowners take out mortgages, they usually receive a valuable option: the right to prepay their

[18] Some investors, called arbitrageurs, will even find ways to sell the fund short to eliminate the risk of holding the futures and the bond, earning a profit from any discrepancy in their prices. We shall cover this type of transaction later in this chapter.

mortgages. When interest rates fall, homeowners often pay off their mortgages, refinancing them at lower rates. The holders of these mortgages usually sell them to other parties, which can include small organizations and individuals. Thus, we often find unsophisticated investors holding securities based on the payments from mortgages. When homeowners refinance, they capture huge interest savings. Where does this money come from? It comes from the pockets of the holders of mortgage securities. When these unsophisticated investors lose a lot of money, derivatives usually get the blame. Yet these losses went into the pockets of homeowners in the form of interest savings. Who is to blame? Probably the brokers, who sold the securities to investors who did not know what they were buying—which leads us to the next common criticism of derivatives.

The complexity of derivatives means that sometimes the parties that use them do not understand them well. As a result, they are often used improperly, leading to potentially large losses. Such an argument can, however, be used to describe fire, electricity, and chemicals. Used improperly, perhaps in the hands of a child or someone who does not know how to use them, all of these can be extremely dangerous. Yet, we know that sufficient knowledge of fire, electricity, and chemicals to use them properly is not very difficult to obtain. The same is true for derivatives; treat them with respect and healthy doses of knowledge.

Derivatives are also mistakenly characterized as a form of legalized gambling. Although gambling is certainly legal in many parts of the world, derivatives are often viewed as a government's sanction of gambling via the financial markets. But there is an important distinction between gambling and derivatives: The benefits of derivatives extend much further across society. By providing a means of managing risk along with the other benefits discussed above, derivatives make financial markets work better. The organized gambling industry affects the participants, the owners of casinos, and perhaps some citizens who benefit from state lotteries. Organized gambling does not, however, make society function better, and it arguably incurs social costs.

We have taken a look at what derivatives are, where they come from, where they are now, why we have them, and what people think of them. Understanding derivatives, however, requires a basic understanding of the market forces that govern derivative prices. Although we shall cover derivative pricing in more detail in later chapters, here we take a brief look at the process of pricing derivatives by examining some important fundamental principles.

7 ELEMENTARY PRINCIPLES OF DERIVATIVE PRICING

In this section, we take a preliminary glance at how derivative contracts are priced. First, we introduce the concept of **arbitrage**. Arbitrage occurs when equivalent assets or combinations of assets sell for two different prices. This situation creates an opportunity to profit at no risk with no commitment of money. Let us start with the simplest (and least likely) opportunity for arbitrage: the case of a stock selling for more than one price at a given time. Assume that a stock is trading in two markets simultaneously. Suppose the stock is trading at \$100 in one market and \$98 in the other market. We simply buy a share for \$98 in one market and immediately sell it for \$100 in the other. We have no net position in the stock, so it does not matter what price the stock moves to. We make an easy \$2 at no risk and we did not have to put up any funds of our own. The sale of the stock at \$100 was more than adequate to finance the purchase of the stock at \$98. Naturally, many market participants would do this, which would create downward pressure on the price of the stock in the market where it trades for \$100 and upward pressure on the price of the stock in the market where it trades for \$98. Eventually the two prices must come together so that there

is but a single price for the stock. Accordingly, the principle that no arbitrage opportunities should be available is often referred to as the **law of one price**.

Recall that we mentioned in Section 5 that an asset can potentially trade in different geographic markets and, therefore, have several spot prices. This potential would appear to violate the law of one price, but in reality, the law is still upheld. A given asset selling in two different locations is not necessarily the same asset. If a buyer in one location discovered that it is possible to buy the asset more cheaply in another location, the buyer would still have to incur the cost of moving the asset to the buyer's location. Transportation costs could offset any such price differences.[19]

Now suppose we face the situation illustrated in Exhibit 1-5 on page 18. In Exhibit 1-5A, observe that we have one stock, AXE Electronics, which today is worth \$50 and which, one period later, will be worth either \$75 or \$40. We shall denote these prices as AXE = 50, $\text{AXE}^+ = 75$, and $\text{AXE}^- = 40$. Another stock, BYF Technology, is today worth \$38 and one period later will be worth \$60 or \$32. Thus, BYF = 38, $\text{BYF}^+ = 60$, and $\text{BYF}^- = 32$. Let us assume the risk-free borrowing and lending rate is 4 percent. We assume no dividends on either stock during the period covered by this example.

The opportunity exists to make a profit at no risk without committing any of our funds, as demonstrated in Exhibit 1-5B. Suppose we borrow 100 shares of stock AXE, which is selling for \$50, and sell short, thereby receiving \$5,000. We take \$4,750 and purchase 125 shares of stock BYF. We invest the remaining \$250 in risk-free bonds at 4 percent. This transaction will not require us to put up any funds of our own: The short sale will be sufficient to fund the investment in BYF and leave money to invest in risk-free bonds.

If the top outcome in Exhibit 1-5 occurs, we sell the 125 shares of BYF for $125 \times \$60 = \$7{,}500$. This amount is sufficient to buy back the 100 shares of AXE, which is selling for \$75. But we will also have the bonds, which are worth $\$250 \times 1.04 = \$260$. If the bottom outcome occurs, we sell the 125 shares of BYF for $125 \times \$32 = \$4{,}000$—enough money to buy back the 100 shares of AXE, which is selling for \$40. Again, we will have the risk-free bonds, worth \$260. Regardless of the outcome, we end up with \$260.

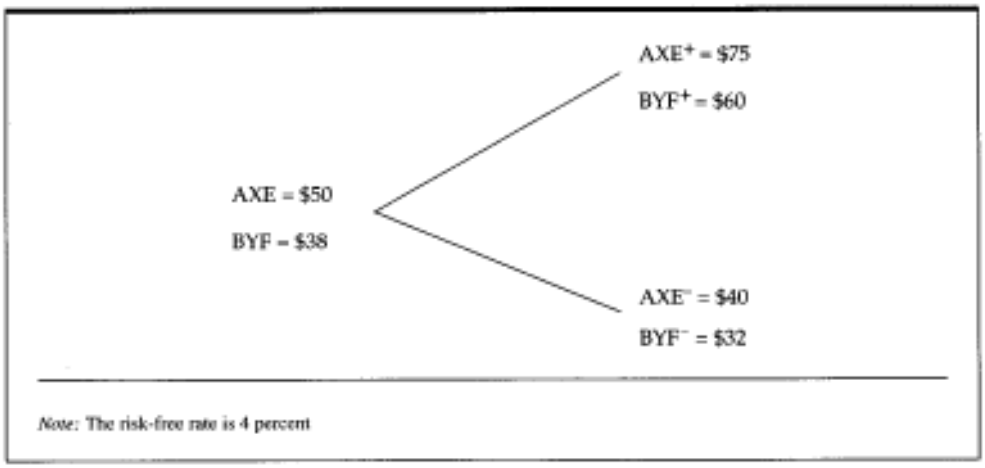
Recall that we put up no money of our own and ended up with a sure \$260. It should be apparent that this is an extremely attractive transaction, so everyone would do it. The combined actions of multiple investors would drive down the price of AXE and/or drive up the price of BYF until an equilibrium was reached at which this transaction would not be profitable. Assuming stock BYF's price remained constant, stock AXE would fall to \$47.50. Or assuming stock AXE's price remained constant, stock BYF would rise to \$40.

Of course, this example is extremely simplified. Clearly a stock price can change to more than two other prices. Also, if a given stock is at one price, another stock may be at any other price. We have created a simple case here to illustrate a point. But as you will learn in Chapter 4, when derivatives are involved, the simplification here is relatively safe. In fact, it is quite appropriate.

Now we look at another type of arbitrage opportunity, which involves a forward contract and will establish an appropriate price for the forward contract. Let stock AXE sell for \$50. We borrow \$50 at 4 percent interest by issuing a risk-free bond, use the money to buy one share of stock AXE, and simultaneously enter into a forward contract to sell this share at a price of \$54 one period later. The stock will then move to either \$75 or \$40 in

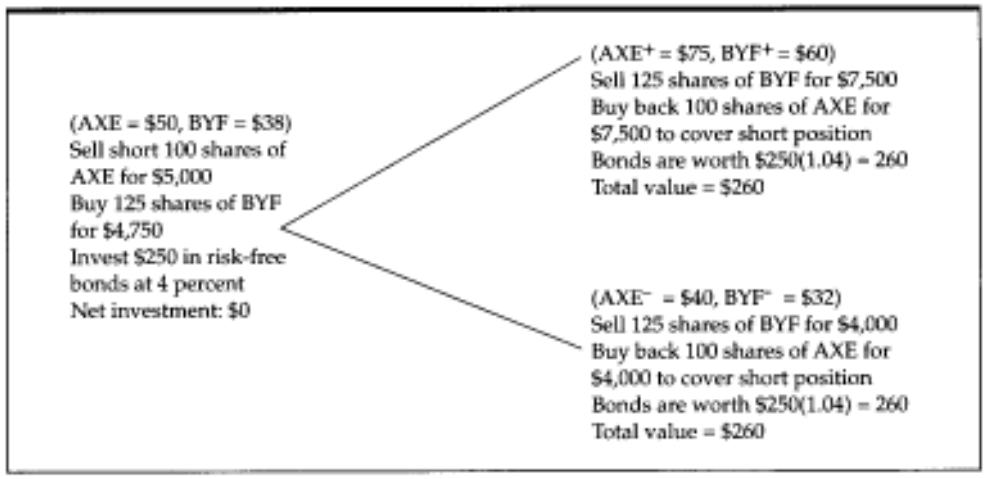
[19] One might reasonably wonder if finding a consumer article selling in Wal-Mart at a lower price than in Target is not a violation of the law of one price. It certainly is, but we make no claim that the market for consumer products is efficient. Our focus is on the financial markets where, for example, Goldman Sachs can hardly offer shares of IBM at one price while Merrill Lynch offers them at another.

EXHIBIT 1-5A Arbitrage Opportunity with Stock AXE, Stock BYF, and a Risk-Free Bond



Note: The risk-free rate is 4 percent

EXHIBIT 1-5B Execution of Arbitrage Transaction with Stock AXE, Stock BYF, and a Risk-Free Bond



the next period; the forward contract will require that we deliver the stock and accept $54 for it; and we shall owe $50 × 1.04 = $52 on the loan.

Let us look at the two outcomes. Suppose stock AXE goes to $75. We deliver the stock to settle the obligation on the forward contract and receive $54 for it. We use $52 of the $54 to pay back the loan, leaving a gain of $2. Now suppose AXE goes to $40. We deliver the stock, fulfilling the obligation of the forward contract, and receive $54. Again, we use $52 of the $54 to pay back the loan, leaving a gain of $2.

In either case we made $2, free and clear. In fact, we can even accommodate the possibility of more than two future prices for AXE. The key point is that we faced no risk and did not have to put up any of our own money, but we ended up with $2—clearly a good deal. In fact, this is what we would call an arbitrage profit. But from where did it originate?

It turns out that the forward price we received, $54, was an inappropriate price given current market conditions. In fact, it was just an arbitrary price, made up to illustrate the

point. To eliminate the opportunity to earn the $2 profit, the forward price should be $52—equal, not coincidentally, to the amount owed on the loan. It is also no coincidence that $52 is the price of the asset increased by the rate of interest. We will discuss this point further in Chapter 2.

In this example, many market participants would do this transaction as long it generates an arbitrage profit. These forces of arbitrage would either force the forward price down or force the price of the stock up until an equilibrium is reached that eliminates the opportunity to profit at no risk with no commitment of one's own funds.

We have just had a taste of not only the powerful forces of arbitrage but also a pricing model for one derivative, the forward contract. In this simple example, according to the pricing model, the forward price should be the spot price increased by the interest rate. Although there is a lot more to derivative pricing than shown here, the basic principle remains the same regardless of the type of instrument or the complexity of the setting: *Prices are set to eliminate the opportunity to profit at no risk with no commitment of one's own funds.* There are no opportunities for arbitrage profits.

Lest we be too naive, however, we must acknowledge that there is a large industry of arbitrageurs. So how can such an industry exist if there are no opportunities for riskless profit? One explanation is that most of the arbitrage transactions are more complex than this simple example and involve estimating information, which can result in differing opinions. Arbitrage involving options, for example, usually requires estimates of a stock's volatility. Different participants have different opinions about this volatility. It is quite possible that two counterparties trading with each other can believe that each is arbitraging against the other.

But more importantly, the absence of arbitrage opportunities is upheld, ironically, only if participants believe that arbitrage opportunities *do* exist. If market traders believe that no opportunities exist to earn arbitrage profits, then they will not follow market prices and compare these prices with what they ought to be, as in the forward contract example given above. Without participants watching closely, prices would surely get out of line and offer arbitrage opportunities. Thus, eliminating arbitrage opportunities requires that participants be vigilant to arbitrage opportunities. In other words, strange as it may sound, disbelief and skepticism concerning the absence of arbitrage opportunities are required in order that it hold as a legitimate principle.

Markets in which arbitrage opportunities are either nonexistent or are quickly eliminated are relatively efficient markets. Recall from your study of portfolio theory and investment analysis that efficient markets are those in which it is not possible, except by chance, to earn returns in excess of those that would be fair compensation for the risk assumed. Although abnormal returns can be earned in a variety of ways, arbitrage profits are definitely examples of abnormal returns, relatively obvious to identify and easy to capture. Thus, they are the most egregious violations of the principle of market efficiency. A market in which arbitrage profits do not exist is one in which the most obvious violations of market efficiency have been eliminated.

Throughout this book, we shall study derivatives by using the principle of arbitrage as a guide. We will assume that arbitrage opportunities cannot exist for any significant length of time. Thus, prices must conform to models that assume no arbitrage. On the other hand, we do not want to take the absence of arbitrage opportunities so seriously that we give up and believe that arbitrage opportunities never exist. Otherwise, they will arise, and someone else will take them from us.

We have now completed this introductory chapter, which has touched only lightly on the world of derivatives. The remainder of the book is organized as follows: Chapter 2 on forwards, Chapter 3 on futures, Chapter 4 on options, and Chapter 5 on swaps provide details describing the types of instruments and how they are priced. Chapter 6 on

forwards and futures, Chapter 7 on options, and Chapter 8 on swaps discuss strategies using these instruments. Chapter 9 covers the integrative topic of risk management, introducing concepts and issues related to the management of risk and some tools and techniques for managing risk. We now proceed to Chapter 2, which looks at forward markets and contracts.

KEY POINTS

- A derivative contract is a financial instrument with a return that is obtained from or "derived" from the return of another underlying financial instrument.
- Exchange-traded derivatives are created, authorized, and traded on a derivatives exchange, an organized facility for trading derivatives. Exchange-traded derivatives are standardized instruments with respect to certain terms and conditions of the contract. They trade in accordance with rules and specifications prescribed by the derivatives exchange and are usually subject to governmental regulation. Exchange-traded derivatives are guaranteed by the exchange against loss resulting from the default of one of the parties. Over-the-counter derivatives are transactions created by any two parties off of a derivatives exchange. The parties set all of their own terms and conditions, and each assumes the credit risk of the other party.
- A forward commitment is an agreement between two parties in which one party agrees to buy and the other agrees to sell an asset at a future date at a price agreed on today. The three types of forward commitments are forward contracts, futures contracts, and swaps.
- A forward contract is a forward commitment created in the over-the-counter market. A futures contract is a forward commitment created and traded on a futures exchange. A swap is an over-the-counter transaction consisting of a series of forward commitments.
- A contingent claim is a derivative contract with a payoff dependent on the occurrence of a future event. The primary types of contingent claims are options, but other types involve variations of options, often combined with other financial instruments or derivatives.
- An option is a derivative contract giving one party the right to buy or sell an underlying asset at a fixed price over a period of time or at a specific point in time. The party obtaining the right pays a premium (the option price) at the start and receives the right to buy or sell, as prescribed by the contract. The two types of options are a call (the right to buy) and a put (the right to sell).
- The size of the global derivatives market can be measured by notional principal, which is the amount of the underlying on which a derivative is based, and by market value, which is the economic worth of the derivative.
- Derivative markets serve many useful purposes such as providing price discovery, facilitating risk management, making markets more efficient, and lowering transaction costs. Derivatives are often criticized as being excessively dangerous for unknowledgeable investors and have been inappropriately likened to gambling.
- Arbitrage is a process through which an investor can buy an asset or combination of assets at one price and concurrently sell at a higher price, thereby earning a profit without investing any money or being exposed to any risk. The combined actions of many investors engaging in arbitrage results in rapid price adjustments that eliminate these opportunities, thereby bringing prices back in line and making markets more efficient.

PROBLEMS

1. For all parties involved, which of the following financial instruments is NOT an example of a forward commitment?
   A. Swap
   B. Call option
   C. Futures contract
   D. Forward contract

2. The main risk faced by an individual who enters into a forward contract to buy the S&P 500 Index is that
   A. the market may rise.
   B. the market may fall.
   C. market volatility may rise.
   D. market volatility may fall.

3. Which of the following statements is *most* accurate?
   A. Futures contracts are private transactions.
   B. Forward contracts are marked to market daily.
   C. Futures contracts have more default risk than forward contracts.
   D. Forward contracts require that both parties to the transaction have a high degree of creditworthiness.

4. Which of the following statements is *least* accurate?
   A. Futures contracts are easier to offset than forward contracts.
   B. Forward contracts are generally more liquid than futures contracts.
   C. Forward contracts are easier to tailor to specific needs than futures contracts.
   D. Futures contracts are characterized by having a clearinghouse as an intermediary.

5. A swap is *best* characterized as a
   A. series of forward contracts.
   B. derivative contract that has not gained widespread popularity.
   C. single fixed payment in exchange for a single floating payment.
   D. contract that is binding on only one of the parties to the transaction.

6. Which of the following is *most* representative of forward contracts and contingent claims?

	Forward Contracts	Contingent Claims
A.	Premium paid at inception	Premium paid at inception
B.	Premium paid at inception	No premium paid at inception
C.	No premium paid at inception	Premium paid at inception
D.	No premium paid at inception	No premium paid at inception

7. For the long position, the *most likely* advantage of contingent claims over forward commitments is that contingent claims
   A. are easier to offset than forward commitments.
   B. have lower default risk than forward commitments.
   C. permit gains while protecting against losses.
   D. are typically cheaper to initiate than forward commitments.

8. For derivative contracts, the notional principal is *best* described as
   A. the amount of the underlying asset covered by the contract.
   B. a measure of the actual payments made and received in the contract.
   C. tending to underestimate the actual payments made and received in the contract.
   D. being, conceptually and in aggregate, the best available measure of the size of the market.

9. By volume, the most widely used group of derivatives is the one with contracts written on which of the following types of underlying assets?
   A. Financial
   B. Commodities
   C. Energy-related
   D. Precious metals

10. Which of the following is *least* likely to be a purpose served by derivative markets?
   A. Arbitrage
   B. Price discovery
   C. Risk management
   D. Hedging and speculation

11. The *most likely* reason derivative markets have flourished is that
   A. derivatives are easy to understand and use.
   B. derivatives have relatively low transaction costs.
   C. the pricing of derivatives is relatively straightforward.
   D. strong regulation ensures that transacting parties are protected from fraud.

12. If the risk-free rate of interest is 5 percent and an investor enters into a transaction that has no risk, the rate of return the investor should earn in the absence of arbitrage opportunities is
   A. 0%.
   B. between 0% and 5%.
   C. 5%.
   D. more than 5%.

13. If the spot price of gold is $250 per ounce and the risk-free rate of interest is 10 percent per annum, the six-month forward price per ounce of gold, in equilibrium, should be *closest* to
   A. $250.00.
   B. $256.25.
   C. $262.50.
   D. $275.00.

14. Concerning efficient financial (including derivative) markets, the *most appropriate* description is that
   A. it is often possible to earn abnormal returns.
   B. the law of one price holds only in the academic literature.
   C. arbitrage opportunities rarely exist and are quickly eliminated.
   D. arbitrage opportunities often exist and can be exploited for profit.

15. Stock A costs $10.00 today and its price will be either $7.50 or $12.50 next period. Stock B's price will be either $18.00 or $30.00 next period. If risk-free borrowing and lending are possible at 8 percent per period, neither stock pays dividends, and it is possible to buy and sell fractional shares, Stock B's equilibrium price today should be *closest* to
   A. $19.00.
   B. $21.00.
   C. $24.00.
   D. $26.00.

SOLUTIONS

1. **B** A call option is not binding on *both* parties in the same sense that the other financial instruments are. The call option gives the holder a right but does not impose an obligation.
2. **B** If the market falls, the buyer of a forward contract could pay more for the index, as determined by the price that was contracted for at the inception of the contract, than the index is worth when the contract matures. Although it is possible that a rise in interest rates could cause the market to fall, this might not always happen and thus is a secondary consideration.
3. **D** Forward contracts are usually private transactions that do not have an intermediary such as a clearinghouse to guarantee performance by both parties. This type of transaction requires a high degree of creditworthiness for both parties.
4. **B** Forward contracts are usually less liquid than futures contracts because they are typically private transactions tailored to suit both parties, unlike futures contracts, which are usually for standardized amounts and are exchange traded.
5. **A** A swap is most like a series of forward contracts. An example is a swap in which one party makes a set of fixed-rate payments over time in exchange for a set of floating-rate payments based on some notional amount.
6. **C** Unlike a contingent claim, a forward commitment typically requires no premium to be paid up front. An intuitive way to look at this is to realize that a forward commitment is binding on both parties, so any up-front fees would cancel, while a contingent claim is binding only on the party in the short position. For this, the party in the short position demands (and receives) compensation.
7. **C** Because the holder of a contingent claim (the party in the long position) has a right but not an obligation, she will only exercise when it is in her best interest to do so and not otherwise. This will happen only when she stands to gain and never when she stands to lose.
8. **A** The notional principal is the amount of the underlying asset covered by the derivative contract.
9. **A** The most widely used derivative contracts are written on underlying assets that are financial, such as Treasury instruments and stock indices.
10. **A** Arbitrage, or the absence of it, is the basis for pricing most derivative contracts. Consequently, it is relatively unusual, although certainly not impossible, for derivative markets to be used to generate arbitrage profits.
11. **B** One reason derivative markets have flourished is that they have relatively low transaction costs. For example, buying a risk-free Treasury security and a futures contract on the S&P 500 Index to replicate payoffs to the index is cheaper than buying the 500 stocks in the index in their proper proportions to get the same payoff.
12. **C** In the absence of arbitrage opportunities, an investor bearing no risk should expect to earn the risk-free rate.
13. **C** The six-month forward price of gold should be $250 \times [1 + (0.10/2)] = 250 \times (1.05) = \$262.50$.
14. **C** Efficient markets are characterized by the absence, or the rapid elimination, of arbitrage opportunities.

15. C Stock B should be priced at \$24.00 today. To see this, imagine selling 2.4 shares of A short for \$24.00, and buying one share of B. Now, in the next period, suppose B is worth \$30.00. Then selling B permits you to buy 2.4 shares of A (at \$12.50 per share) to return the shares sold short. Alternatively, if B is worth \$18.00, selling B permits you to still buy 2.4 shares of A (at \$7.50) to return them. The same no-profit situation holds if you sell one share of B and buy 2.4 shares of A. An alternative explanation lies in the fact that in each of the two outcomes, the price of B is 2.4 times the price of A. Thus, the price of B today must be 2.4 times the price of A.