CHAPTER 1

DERIVATIVE MARKETS AND INSTRUMENTS

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LEARNING OUTCOMES

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

- define a derivative and distinguish between exchange-traded and over-the-counter derivatives;
- contrast forward commitments with contingent claims;
- define forward contracts, futures contracts, options (calls and puts), swaps, and credit derivatives and compare their basic characteristics;
- describe purposes of, and controversies related to, derivative markets;
- explain arbitrage and the role it plays in determining prices and promoting market efficiency.

1. INTRODUCTION

Equity, fixed-income, currency, and commodity markets are facilities for trading the basic assets of an economy. Equity and fixed-income securities are claims on the assets of a company. Currencies are the monetary units issued by a government or central bank. Commodities are natural resources, such as oil or gold. These underlying assets are said to trade in **cash markets** or **spot markets** and their prices are sometimes referred to as **cash prices** or **spot prices**, though we usually just refer to them as stock prices, bond prices, exchange rates, and commodity prices. These markets exist around the world and receive much attention in the financial and mainstream media. Hence, they are relatively familiar not only to financial experts but also to the general population.

Somewhat less familiar are the markets for **derivatives**, which are financial instruments that derive their values from the performance of these basic assets. This reading is an overview of derivatives. Subsequent readings will explore many aspects of derivatives and their uses in depth. Among the questions that this first reading will address are the following:

- What are the defining characteristics of derivatives?
- What purposes do derivatives serve for financial market participants?
- What is the distinction between a forward commitment and a contingent claim?
- What are forward and futures contracts? In what ways are they alike and in what ways are they different?
- What are swaps?
- What are call and put options and how do they differ from forwards, futures, and swaps?
- What are credit derivatives and what are the various types of credit derivatives?
- What are the benefits of derivatives?
- What are some criticisms of derivatives and to what extent are they well founded?
- What is arbitrage and what role does it play in a well-functioning financial market?

This reading is organized as follows. Section 2 explores the definition and uses of derivatives and establishes some basic terminology. Section 3 describes derivatives markets. Section 4 categorizes and explains types of derivatives. Sections 5 and 6 discuss the benefits and criticisms of derivatives, respectively. Section 7 introduces the basic principles of derivative pricing and the concept of arbitrage. Section 8 provides a summary.

2. DERIVATIVES: DEFINITIONS AND USES

The most common definition of a derivative reads approximately as follows:

> *A derivative is a financial instrument that derives its performance from the performance of an underlying asset.*

This definition, despite being so widely quoted, can nonetheless be a bit troublesome. For example, it can also describe mutual funds and exchange-traded funds, which would never be viewed as derivatives even though they derive their values from the values of the underlying securities they hold. Perhaps the distinction that best characterizes derivatives is that they usually *transform* the performance of the underlying asset before paying it out in the derivatives transaction. In contrast, with the exception of expense deductions, mutual funds and exchange-traded funds simply pass through the returns of their underlying securities. This transformation of performance is typically understood or implicit in references to derivatives but rarely makes its way into the formal definition. In keeping with customary industry practice, this characteristic will be retained as an implied, albeit critical, factor distinguishing derivatives from mutual funds and exchange-traded funds and some other straight pass-through instruments. Also, note that the idea that derivatives take their *performance* from an underlying asset encompasses the fact that derivatives take their value and certain other characteristics from the underlying asset. Derivatives strategies perform in ways that are derived from the underlying and the specific features of derivatives.

Derivatives are similar to insurance in that both allow for the transfer of risk from one party to another. As everyone knows, insurance is a financial contract that provides protection against loss. The party bearing the risk purchases an insurance policy, which transfers the risk to the other party, the insurer, for a specified period of time. The risk itself does not change, but the party bearing it does. Derivatives allow for this same type of transfer of risk. One type of derivative in particular, the put option, when combined with a position exposed to the risk, functions almost exactly like insurance, but all derivatives can be used to protect against loss. Of course, an insurance contract must specify the underlying risk, such as property, health, or life. Likewise, so do derivatives. As noted earlier, derivatives are associated with an underlying asset. As such, the so-called "underlying asset" is often simply referred to as the **underlying**, whose value is the source of risk.[1] In fact, the underlying need not even be an asset itself. Although common derivatives underlyings are equities, fixed-income securities, currencies, and commodities, other derivatives underlyings include interest rates, credit, energy, weather, and even other derivatives, all of which are not generally thought of as assets. Thus, like insurance, derivatives pay off on the basis of a source of risk, which is often, but not always, the value of an underlying asset. And like insurance, derivatives have a definite life span and expire on a specified date.

Derivatives are created in the form of legal contracts. They involve two parties—the buyer and the seller (sometimes known as the writer)—each of whom agrees to do something for the other, either now or later. The buyer, who purchases the derivative, is referred to as the **long** or the holder because he owns (holds) the derivative and holds a long position. The seller is referred to as the **short** because he holds a short position.[2]

A derivative contract always defines the rights and obligations of each party. These contracts are intended to be, and almost always are, recognized by the legal system as commercial contracts that each party expects to be upheld and supported in the legal system. Nonetheless, disputes sometimes arise, and lawyers, judges, and juries may be required to step in and resolve the matter.

There are two general classes of derivatives. Some provide the ability to lock in a price at which one might buy or sell the underlying. Because they force the two parties to transact in the future at a previously agreed-on price, these instruments are called **forward commitments**. The various types of forward commitments are called forward contracts, futures contracts, and swaps. Another class of derivatives provides *the right but not the obligation* to buy or sell the underlying at a pre-determined price. Because the choice of buying or selling versus doing nothing depends on a particular random outcome, these derivatives are called **contingent claims**. The primary contingent claim is called an **option**. The types of derivatives will be covered in more detail later in this reading and in considerably more depth later in the curriculum.

The existence of derivatives begs the obvious question of what purpose they serve. If one can participate in the success of a company by holding its equity, what reason can possibly explain why another instrument is required that takes its value from the performance of the equity? Although equity and other fundamental markets exist and usually perform reasonably well without derivative markets, it is possible that derivative markets can *improve* the performance of the markets for the underlyings. As you will see later in this reading, that is indeed true in practice.

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[1] Unfortunately, English financial language often evolves without regard to the rules of proper usage. *Underlying* is typically an adjective and, therefore, a modifier, but the financial world has turned it into a noun.

[2] In the financial world, the *long* always benefits from an increase in the value of the instrument he owns, and the *short* always benefits from a decrease in the value of the instrument he has sold. Think of the long as having possession of something and the short as having incurred an obligation to deliver that something.

Derivative markets create beneficial opportunities that do not exist in their absence. Derivatives can be used to create strategies that cannot be implemented with the underlyings alone. For example, derivatives make it easier to go short, thereby benefiting from a decline in the value of the underlying. In addition, derivatives, in and of themselves, are characterized by a relatively high degree of leverage, meaning that participants in derivatives transactions usually have to invest only a small amount of their own capital relative to the value of the underlying. As such, small movements in the underlying can lead to fairly large movements in the amount of money made or lost on the derivative. Derivatives generally trade at lower transaction costs than comparable spot market transactions, are often more liquid than their underlyings, and offer a simple, effective, and low-cost way to transfer risk. For example, a shareholder of a company can reduce or even completely eliminate the market exposure by trading a derivative on the equity. Holders of fixed-income securities can use derivatives to reduce or completely eliminate interest rate risk, allowing them to focus on the credit risk. Alternatively, holders of fixed-income securities can reduce or eliminate the credit risk, focusing more on the interest rate risk. Derivatives permit such adjustments easily and quickly. These features of derivatives are covered in more detail later in this reading.

The types of performance transformations facilitated by derivatives allow market participants to practice more effective risk management. Indeed, the entire field of derivatives, which at one time was focused mostly on the instruments themselves, is now more concerned with the *uses* of the instruments. Just as a carpenter uses a hammer, nails, screws, a screwdriver, and a saw to build something useful or beautiful, a financial expert uses derivatives to manage risk. And just as it is critically important that a carpenter understands how to use these tools, an investment practitioner must understand how to properly use derivatives. In the case of the carpenter, the result is building something useful; in the case of the financial expert, the result is managing financial risk. Thus, like tools, derivatives serve a valuable purpose but like tools, they must be used carefully.

The practice of risk management has taken a prominent role in financial markets. Indeed, whenever companies announce large losses from trading, lending, or operations, stories abound about how poorly these companies managed risk. Such stories are great attention grabbers and a real boon for the media, but they often miss the point that risk management does not guarantee that large losses will not occur. Rather, **risk management** *is the process by which an organization or individual defines the level of risk it wishes to take, measures the level of risk it is taking, and adjusts the latter to equal the former*. Risk management never offers a guarantee that large losses will not occur, and it does not eliminate the possibility of total failure. To do so would typically require that the amount of risk taken be so small that the organization would be effectively constrained from pursuing its primary objectives. Risk taking is inherent in all forms of economic activity and life in general. The possibility of failure is never eliminated.

EXAMPLE 1 Characteristics of Derivatives

1. Which of the following is the best example of a derivative?
   A. A global equity mutual fund
   B. A non-callable government bond
   C. A contract to purchase Apple Computer at a fixed price

2. Which of the following is **not** a characteristic of a derivative?
   A. An underlying
   B. A low degree of leverage
   C. Two parties—a buyer and a seller
3. Which of the following statements about derivatives is **not** true?
   A. They are created in the spot market.
   B. They are used in the practice of risk management.
   C. They take their values from the value of something else.

Solution to 1: C is correct. Mutual funds and government bonds are not derivatives. A government bond is a fundamental asset on which derivatives might be created, but it is not a derivative itself. A mutual fund can technically meet the definition of a derivative, but as noted in the reading, derivatives transform the value of a payoff of an underlying asset. Mutual funds merely pass those payoffs through to their holders.

Solution to 2: B is correct. All derivatives have an underlying and must have a buyer and a seller. More importantly, derivatives have high degrees of leverage, not low degrees of leverage.

Solution to 3: A is correct. Derivatives are used to practice risk management and they take (derive) their values from the value of something else, the underlying. They are not created in the spot market, which is where the underlying trades.

Note also that risk management is a dynamic and ongoing process, reflecting the fact that the risk assumed can be difficult to measure and is constantly changing. As noted, derivatives are tools, indeed *the* tools that make it easier to manage risk. Although one can trade stocks and bonds (the underlyings) to adjust the level of risk, it is almost always more effective to trade derivatives.

Risk management is addressed more directly elsewhere in the CFA curriculum, but the study of derivatives necessarily entails the concept of risk management. In an explanation of derivatives, the focus is usually on the instruments and it is easy to forget the overriding objective of managing risk. Unfortunately, that would be like a carpenter obsessed with his hammer and nails, forgetting that he is building a piece of furniture. It is important to always try to keep an eye on the objective of managing risk.

3. THE STRUCTURE OF DERIVATIVE MARKETS

Having an understanding of equity, fixed-income, and currency markets is extremely beneficial—indeed, quite necessary—in understanding derivatives. One could hardly consider the wisdom of using derivatives on a share of stock if one did not understand the equity markets reasonably well. As you likely know, equities trade on organized exchanges as well as in over-the-counter (OTC) markets. These exchange-traded equity markets—such as the Deutsche Börse, the Tokyo Stock Exchange, and the New York Stock Exchange and its Eurex affiliate—are formal organizational structures that bring buyers and sellers together through market makers, or dealers, to facilitate transactions. Exchanges have formal rule structures and are required to comply with all securities laws.

OTC securities markets operate in much the same manner, with similar rules, regulations, and organizational structures. At one time, the major difference between OTC and exchange markets for securities was that the latter brought buyers and sellers together in a physical location, whereas the former facilitated trading strictly in an electronic manner. Today, these distinctions are blurred because many organized securities exchanges have gone completely to electronic systems. Moreover, OTC securities markets can be formally organized structures, such as NASDAQ, or can merely refer to informal networks of parties who buy and sell with each other, such as the corporate and government bond markets in the United States.

The derivatives world also comprises organized exchanges and OTC markets. Although the derivatives world is also moving toward less distinction between these markets, there are clear differences that are important to understand.

3.1. Exchange-Traded Derivatives Markets

Derivative instruments are created and traded either on an exchange or on the OTC market. Exchange-traded derivatives are standardized, whereas OTC derivatives are customized. To standardize a derivative contract means that its terms and conditions are precisely specified by the exchange and there is very limited ability to alter those terms. For example, an exchange might offer trading in certain types of derivatives that expire only on the third Friday of March, June, September, and December. If a party wanted the derivative to expire on any other day, it would not be able to trade such a derivative on that exchange, nor would it be able to persuade the exchange to create it, at least not in the short run. If a party wanted a derivative on a particular entity, such as a specific stock, that party could trade it on that exchange only if the exchange had specified that such a derivative could trade. Even the magnitudes of the contracts are specified. If a party wanted a derivative to cover €150,000 and the exchange specified that contracts could trade only in increments of €100,000, the party could do nothing about it if it wanted to trade that derivative on that exchange.

This standardization of contract terms facilitates the creation of a more liquid market for derivatives. If all market participants know that derivatives on the euro trade in 100,000-unit lots and that they all expire only on certain days, the market functions more effectively than it would if there were derivatives with many different unit sizes and expiration days competing in the same market at the same time. This standardization makes it easier to provide liquidity. Through designated market makers, derivatives exchanges guarantee that derivatives can be bought and sold.[3]

The cornerstones of the exchange-traded derivatives market are the market makers (or dealers) and the speculators, both of whom typically own memberships on the exchange.[4] The

[3]It is important to understand that merely being able to buy and sell a derivative, or even a security, does not mean that liquidity is high and that the cost of liquidity is low. Derivatives exchanges guarantee that a derivative can be bought and sold, but they do not guarantee the price. The ask price (the price at which the market maker will sell) and the bid price (the price at which the market maker will buy) can be far apart, which they will be in a market with low liquidity. Hence, such a market can have liquidity, loosely defined, but the cost of liquidity can be quite high. The factors that can lead to low liquidity for derivatives are similar to those for securities: little trading interest and a high level of uncertainty.

[4]Exchanges are owned by their *members*, whose memberships convey the right to trade. In addition, some exchanges are themselves publicly traded corporations whose members are shareholders, and there are also non-member shareholders.

market makers stand ready to buy at one price and sell at a higher price. With standardization of terms and an active market, market makers are often able to buy and sell almost simultaneously at different prices, locking in small, short-term profits—a process commonly known as scalping. In some cases, however, they are unable to do so, thereby forcing them to either hold exposed positions or find other parties with whom they can trade and thus lay off (get rid of) the risk. This is when speculators come in. Although speculators are market participants who are willing to take risks, it is important to understand that being a speculator does not mean the reckless assumption of risk. Although speculators will take large losses at times, good speculators manage those risks by watching their exposures, absorbing market information, and observing the flow of orders in such a manner that they are able to survive and profit. Often, speculators will hedge their risks when they become uncomfortable.

Standardization also facilitates the creation of a clearing and settlement operation. **Clearing** refers to the process by which the exchange verifies the execution of a transaction and records the participants' identities. **Settlement** refers to the related process in which the exchange transfers money from one participant to the other or from a participant to the exchange or vice versa. This flow of money is a critical element of derivatives trading. Clearly, there would be no confidence in markets in which money is not efficiently collected and disbursed. Derivatives exchanges have done an excellent job of clearing and settlement, especially in comparison to securities exchanges. Derivatives exchanges clear and settle all contracts overnight, whereas most securities exchanges require two business days.

The clearing and settlement process of derivative transactions also provides a credit guarantee. If two parties engage in a derivative contract on an exchange, one party will ultimately make money and the other will lose money. Derivatives exchanges use their clearinghouses to provide a guarantee to the winning party that if the loser does not pay, the clearinghouse will pay the winning party. The clearinghouse is able to provide this credit guarantee by requiring a cash deposit, usually called the **margin bond** or **performance bond**, from the participants to the contract. Derivatives clearinghouses manage these deposits, occasionally requiring additional deposits, so effectively that they have never failed to pay in the nearly 100 years they have existed. We will say more about this process later and illustrate how it works.

Exchange markets are said to have **transparency**, which means that full information on all transactions is disclosed to exchanges and regulatory bodies. All transactions are centrally reported within the exchanges and their clearinghouses, and specific laws require that these markets be overseen by national regulators. Although this would seem a strong feature of exchange markets, there is a definite cost. Transparency means a loss of privacy: National regulators can see what transactions have been done. Standardization means a loss of flexibility: A participant can do only the transactions that are permitted on the exchange. Regulation means a loss of both privacy and flexibility. It is not that transparency or regulation is good and the other is bad. It is simply a trade-off.

Derivatives exchanges exist in virtually all developed (and some emerging market) countries around the world. Some exchanges specialize in derivatives and others are integrated with securities exchanges.

Although there have been attempts to create somewhat non-standardized derivatives for trading on an exchange, such attempts have not been particularly successful. Standardization is a critical element by which derivatives exchanges are able to provide their services. We will look at this point again when discussing the alternative to standardization: customized OTC derivatives.

3.2. Over-the-Counter Derivatives Markets

The OTC derivatives markets comprise an informal network of market participants that are willing to create and trade virtually any type of derivative that can legally exist. The backbone of these markets is the set of dealers, which are typically banks. Most of these banks are members of a group called the International Swaps and Derivatives Association (ISDA), a worldwide organization of financial institutions that engage in derivative transactions, primarily as dealers. As such, these markets are sometimes called *dealer markets*. Acting as principals, these dealers informally agree to buy and sell various derivatives. It is *informal* because the dealers are not obligated to do so. Their participation is based on a desire to profit, which they do by purchasing at one price and selling at a higher price. Although it might seem that a dealer who can "buy low, sell high" could make money easily, the process in practice is not that simple. Because OTC instruments are not standardized, a dealer cannot expect to buy a derivative at one price and simultaneously sell it to a different party who happens to want to buy the same derivative at the same time and at a higher price.

To manage the risk they assume by buying and selling customized derivatives, OTC derivatives dealers typically hedge their risks by engaging in alternative but similar transactions that pass the risk on to other parties. For example, if a company comes to a dealer to buy a derivative on the euro, the company would effectively be transferring the risk of the euro to the dealer. The dealer would then attempt to lay off (get rid of) that risk by engaging in an alternative but similar transaction that would transfer the risk to another party. This hedge might involve another derivative on the euro or it might simply be a transaction in the euro itself. Of course, that begs the question of why the company could not have laid off the risk itself and avoided the dealer. Indeed, some can and do, but laying off risk is not simple. Unable to find identical offsetting transactions, dealers usually have to find *similar* transactions with which they can lay off the risk. Hedging one derivative with a different kind of derivative on the same underlying is a similar but not identical transaction. It takes specialized knowledge and complex models to be able to do such transactions effectively, and dealers are more capable of doing so than are ordinary companies. Thus, one might think of a dealer as a middleman, a sort of financial wholesaler using its specialized knowledge and resources to facilitate the transfer of risk. In the same manner that one could theoretically purchase a consumer product from a manufacturer, a network of specialized middlemen and retailers is often a more effective method.

Because of the customization of OTC derivatives, there is a tendency to think that the OTC market is less liquid than the exchange market. That is not necessarily true. Many OTC instruments can easily be created and then essentially offset by doing the exact opposite transaction, often with the same party. For example, suppose Corporation A buys an OTC derivative from Dealer B. Before the expiration date, Corporation A wants to terminate the position. It can return to Dealer B and ask to sell a derivative with identical terms. Market conditions will have changed, of course, and the value of the derivative will not be the same, but the transaction can be conducted quite easily with either Corporation A or Dealer B netting a gain at the expense of the other. Alternatively, Corporation A could do this transaction with a different dealer, the result of which would remove exposure to the underlying risk but would leave two transactions open and some risk that one party would default to the other. In contrast to this type of OTC liquidity, some exchange-traded derivatives have very little trading interest and thus relatively low liquidity. Liquidity is always driven by trading interest, which can be strong or weak in both types of markets.

OTC derivative markets operate at a lower degree of regulation and oversight than do exchange-traded derivative markets. In fact, until around 2010, it could largely be said that the

OTC market was essentially unregulated. OTC transactions could be executed with only the minimal oversight provided through laws that regulated the parties themselves, not the specific instruments. Following the financial crisis that began in 2007, new regulations began to blur the distinction between OTC and exchange-listed markets. In both the United States (the Wall Street Reform and Consumer Protection Act of 2010, commonly known as the Dodd–Frank Act) and Europe (the Regulation of the European Parliament and of the Council on OTC Derivatives, Central Counterparties, and Trade Repositories), regulations are changing the characteristics of OTC markets.

When the full implementation of these new laws takes place, a number of OTC transactions will have to be cleared through central clearing agencies, information on most OTC transactions will need to be reported to regulators, and entities that operate in the OTC market will be more closely monitored. There are, however, quite a few exemptions that cover a significant percentage of derivative transactions. Clearly, the degree of OTC regulation, although increasing in recent years, is still lighter than that of exchange-listed market regulation. Many transactions in OTC markets will retain a degree of privacy with lower transparency, and most importantly, the OTC markets will remain considerably more flexible than the exchange-listed markets.

EXAMPLE 2 Exchange-Traded versus Over-the-Counter Derivatives

1. Which of the following characteristics is **not** associated with exchange-traded derivatives?
   A. Margin or performance bonds are required.
   B. The exchange guarantees all payments in the event of default.
   C. All terms except the price are customized to the parties' individual needs.
2. Which of the following characteristics is associated with over-the-counter derivatives?
   A. Trading occurs in a central location.
   B. They are more regulated than exchange-listed derivatives.
   C. They are less transparent than exchange-listed derivatives.
3. Market makers earn a profit in both exchange and over-the-counter derivatives markets by:
   A. charging a commission on each trade.
   B. a combination of commissions and markups.
   C. buying at one price, selling at a higher price, and hedging any risk.
4. Which of the following statements *most* accurately describes exchange-traded derivatives relative to over-the-counter derivatives? Exchange-traded derivatives are more likely to have:
   A. greater credit risk.
   B. standardized contract terms.
   C. greater risk management uses.

Solution to 1: C is correct. Exchange-traded contracts are standardized, meaning that the exchange determines the terms of the contract except the price. The exchange guarantees against default and requires margins or performance bonds.

Solution to 2: C is correct. OTC derivatives have a lower degree of transparency than exchange-listed derivatives. Trading does not occur in a central location but, rather, is quite dispersed. Although new national securities laws are tightening the regulation of OTC derivatives, the degree of regulation is less than that of exchange-listed derivatives.

Solution to 3: C is correct. Market makers buy at one price (the bid), sell at a higher price (the ask), and hedge whatever risk they otherwise assume. Market makers do not charge a commission. Hence, A and B are both incorrect.

Solution to 4: B is correct. Standardization of contract terms is a characteristic of exchange-traded derivatives. A is incorrect because credit risk is well-controlled in exchange markets. C is incorrect because the risk management uses are not limited by being traded over the counter.

4. TYPES OF DERIVATIVES

As previously stated, derivatives fall into two general classifications: forward commitments and contingent claims. The factor that distinguishes forward commitments from contingent claims is that the former *obligate* the parties to engage in a transaction at a future date on terms agreed upon in advance, whereas the latter provide one party the *right but not the obligation* to engage in a future transaction on terms agreed upon in advance.

4.1. Forward Commitments

Forward commitments are contracts entered into at one point in time that require both parties to engage in a transaction at a later point in time (the expiration) on terms agreed upon at the start. The parties establish the identity and quantity of the underlying, the manner in which the contract will be executed or settled when it expires, and the fixed price at which the underlying will be exchanged. This fixed price is called the **forward price**.

As a hypothetical example of a forward contract, suppose that today Markus and Johannes enter into an agreement that Markus will sell his BMW to Johannes for a price of €30,000. The transaction will take place on a specified date, say, 180 days from today. At that time, Markus will deliver the vehicle to Johannes's home and Johannes will give Markus a bank-certified check for €30,000. There will be no recourse, so if the vehicle has problems later, Johannes cannot go back to Markus for compensation. It should be clear that both Markus and Johannes must do their due diligence and carefully consider the reliability of each other. The car could have serious quality issues and Johannes could have financial problems and be unable to pay the €30,000. Obviously, the transaction is essentially unregulated. Either party could renege on his obligation, in response to which the other party could go to court, provided a formal contract exists and is carefully written. Note finally that one of the two parties is likely to end up gaining and the other losing, depending on the secondary market price of this type of vehicle at expiration of the contract.

This example is quite simple but illustrates the essential elements of a forward contract. In the financial world, such contracts are very carefully written, with legal provisions that guard against fraud and require extensive credit checks. Now let us take a deeper look at the characteristics of forward contracts.

4.1.1. Forward Contracts

The following is the formal definition of a forward contract:

> *A forward contract is an over-the-counter derivative contract in which two parties agree that one party, the buyer, will purchase an underlying asset from the other party, the seller, at a later date at a fixed price they agree on when the contract is signed.*

In addition to agreeing on the price at which the underlying asset will be sold at a later date, the two parties also agree on several other matters, such as the specific identity of the underlying, the number of units of the underlying that will be delivered, and where the future delivery will occur. These are important points but relatively minor in this discussion, so they can be left out of the definition to keep it uncluttered.

As noted earlier, a forward contract is a commitment. Each party agrees that it will fulfill its responsibility at the designated future date. Failure to do so constitutes a default and the non-defaulting party can institute legal proceedings to enforce performance. It is important to recognize that although either party could default to the other, only one party at a time can default. The party owing the greater amount could default to the other, but the party owing the lesser amount cannot default because its claim on the other party is greater. The amount owed is always based on the net owed by one party to the other.

To gain a better understanding of forward contracts, it is necessary to examine their payoffs. As noted, forward contracts—and indeed all derivatives—take (derive) their payoffs from the performance of the underlying asset. To illustrate the payoff of a forward contract, start with the assumption that we are at time $t = 0$ and that the forward contract expires at a later date, time $t = T$.[5] The spot price of the underlying asset at time 0 is S_0 and at time T is S_T. Of course, when we initiate the contract at time 0, we do not know what S_T will ultimately be. Remember that the two parties, the buyer and the seller, are going long and short, respectively.

At time $t = 0$, the long and the short agree that the short will deliver the asset to the long at time T for a price of $F_0(T)$. The notation $F_0(T)$ denotes that this value is established at time 0 and applies to a contract expiring at time T. $F_0(T)$ is the forward price. Later, you will learn how the forward price is determined. It turns out that it is quite easy to do, but we do not need to know right now.[6]

So, let us assume that the buyer enters into the forward contract with the seller for a price of $F_0(T)$, with delivery of one unit of the underlying asset to occur at time T. Now, let us roll forward to time T, when the price of the underlying is S_T. The long is obligated to pay $F_0(T)$, for which he receives an asset worth S_T. If $S_T > F_0(T)$, it is clear that the transaction has worked out well for the long. He paid $F_0(T)$ and receives something of greater value. Thus, the contract effectively pays off $S_T - F_0(T)$ to the long, which is the value of the contract at expiration. The short has the mirror image of the long. He is required to deliver the asset worth S_T and accept a smaller amount, $F_0(T)$. The contract has a payoff for him of $F_0(T) - S_T$, which

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[5] Such notations as $t = 0$ and $t = T$ are commonly used in explaining derivatives. To indicate that $t = 0$ simply means that we initiate a contract at an imaginary time designated like a counter starting at zero. To indicate that the contract expires at $t = T$ simply means that at some future time, designated as T, the contract expires. Time T could be a certain number of days from now or a fraction of a year later or T years later. We will be more specific in later readings that involve calculations. For now, just assume that $t = 0$ and $t = T$ are two dates—the initiation and the expiration—of the contract.

[6] This point is covered more fully elsewhere in the readings on derivatives, but we will see it briefly later in this reading.

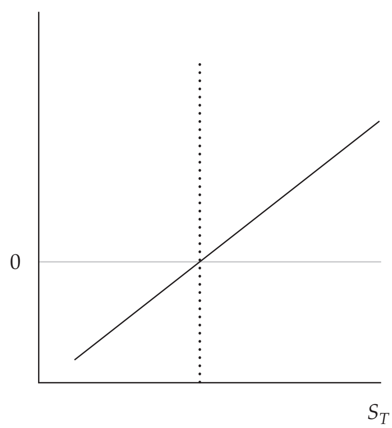
is negative. Even if the asset's value, S_T, is less than the forward price, $F_0(T)$, the payoffs are still $S_T - F_0(T)$ for the long and $F_0(T) - S_T$ for the short. We can consolidate these results by writing the short's payoff as the negative of the long's, $-[S_T - F_0(T)]$, which serves as a useful reminder that the long and the short are engaged in a zero-sum game, which is a type of competition in which one participant's gains are the other's losses. Although both lose a modest amount in the sense of both having some costs to engage in the transaction, these costs are relatively small and worth ignoring for our purposes at this time. In addition, it is worthwhile to note how derivatives transform the performance of the underlying. The gain from owning the underlying would be $S_T - S_0$, whereas the gain from owning the forward contract would be $S_T - F_0(T)$. Both figures are driven by S_T, the price of the underlying at expiration, but they are not the same.

Exhibit 1 illustrates the payoffs from both buying and selling a forward contract.

EXHIBIT 1 Payoffs from a Forward Contract

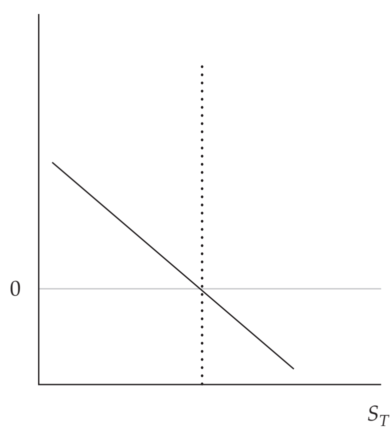
A. Payoff from Buying = $S_T - F_0(T)$

Payoff



B. Payoff from Selling = $-[S_T - F_0(T)]$

Payoff



The long hopes the price of the underlying will rise above the forward price, $F_0(T)$, whereas the short hopes the price of the underlying will fall below the forward price. Except in the extremely rare event that the underlying price at T equals the forward price, there will ultimately be a winner and a loser.

An important element of forward contracts is that no money changes hands between parties when the contract is initiated. Unlike in the purchase and sale of an asset, there is no value exchanged at the start. The buyer does not pay the seller some money and obtain something. In fact, forward contracts have zero value at the start. They are neither assets nor liabilities. As you will learn in later readings, their values will deviate from zero later as prices move. Forward contracts will almost always have non-zero values at expiration.

As noted previously, the primary purpose of derivatives is for risk management. Although the uses of forward contracts are covered in depth later in the curriculum, there are a few things to note here about the purposes of forward contracts. It should be apparent that locking in the future buying or selling price of an underlying asset can be extremely attractive for some parties. For example, an airline anticipating the purchase of jet fuel at a later date can enter into a forward contract to buy the fuel at a price agreed upon when the contract is initiated. In so doing, the airline has hedged its cost of fuel. Thus, forward contracts can be structured to create a perfect hedge, providing an assurance that the underlying asset can be bought or sold at a price known when the contract is initiated. Likewise, speculators, who ultimately assume the risk laid off by hedgers, can make bets on the direction of the underlying asset without having to invest the money to purchase the asset itself.

Finally, forward contracts need not specifically settle by delivery of the underlying asset. They can settle by an exchange of cash. These contracts—called **non-deliverable forwards** (NDFs), **cash-settled forwards**, or **contracts for differences**—have the same economic effect as do their delivery-based counterparts. For example, for a physical delivery contract, if the long pays $F_0(T)$ and receives an asset worth S_T, the contract is worth $S_T - F_0(T)$ to the long at expiration. A non-deliverable forward contract would have the short simply pay cash to the long in the amount of $S_T - F_0(T)$. The long would not take possession of the underlying asset, but if he wanted the asset, he could purchase it in the market for its current price of S_T. Because he received a cash settlement in the amount of $S_T - F_0(T)$, in buying the asset the long would have to pay out only $S_T - [S_T - F_0(T)]$, which equals $F_0(T)$. Thus, the long could acquire the asset, effectively paying $F_0(T)$, exactly as the contract promised. Transaction costs do make cash settlement different from physical delivery, but this point is relatively minor and can be disregarded for our purposes here.

As previously mentioned, forward contracts are OTC contracts. There is no formal forward contract exchange. Nonetheless, there are exchange-traded variants of forward contracts, which are called futures contracts or just futures.

4.1.2. Futures

Futures contracts are specialized versions of forward contracts that have been standardized and that trade on a futures exchange. By standardizing these contracts and creating an organized market with rules, regulations, and a central clearing facility, the futures markets offer an element of liquidity and protection against loss by default.

Formally, a futures contract is defined as follows:

A futures contract is a standardized derivative contract created and traded on a futures exchange in which two parties agree that one party, the buyer, will purchase an underlying *asset from the other party, the seller, at a later date and at a price agreed on by the two parties when the contract is initiated and in which there is a daily settling of gains and losses and a credit guarantee by the futures exchange through its clearinghouse.*

First, let us review what standardization means. Recall that in forward contracts, the parties customize the contract by specifying the underlying asset, the time to expiration, the delivery and settlement conditions, and the quantity of the underlying, all according to whatever terms they agree on. These contracts are not traded on an exchange. As noted, the regulation of OTC derivatives markets is increasing, but these contracts are not subject to the traditionally high degree of regulation that applies to securities and futures markets. Futures contracts first require the existence of a futures exchange, a legally recognized entity that provides a market for trading these contracts. Futures exchanges are highly regulated at the national level in all countries. These exchanges specify that only certain contracts are authorized for trading. These contracts have specific underlying assets, times to expiration, delivery and settlement conditions, and quantities. The exchange offers a facility in the form of a physical location and/or an electronic system as well as liquidity provided by authorized market makers.

Probably the most important distinctive characteristic of futures contracts is the daily settlement of gains and losses and the associated credit guarantee provided by the exchange through its clearinghouse. When a party buys a futures contract, it commits to purchase the underlying asset at a later date and at a price agreed upon when the contract is initiated. The counterparty (the seller) makes the opposite commitment, an agreement to sell the underlying asset at a later date and at a price agreed upon when the contract is initiated. The agreed-upon price is called the **futures price**. Identical contracts trade on an ongoing basis at different prices, reflecting the passage of time and the arrival of new information to the market. Thus, as the futures price changes, the parties make and lose money. Rising (falling) prices, of course, benefit (hurt) the long and hurt (benefit) the short. At the end of each day, the clearinghouse engages in a practice called **mark to market**, also known as the **daily settlement**. The clearinghouse determines an average of the final futures trades of the day and designates that price as the **settlement price**. All contracts are then said to be *marked to the settlement price*. For example, if the long purchases the contract during the day at a futures price of £120 and the settlement price at the end of the day is £122, the long's account would be marked for a gain of £2. In other words, the long has made a profit of £2 and that amount is credited to his account, with the money coming from the account of the short, who has lost £2. Naturally, if the futures price decreases, the long loses money and is charged with that loss, and the money is transferred to the account of the short.[7]

The account is specifically referred to as a **margin** account. Of course, in equity markets, margin accounts are commonly used, but there are significant differences between futures margin accounts and equity margin accounts. Equity margin accounts involve the extension of credit. An investor deposits part of the cost of the stock and borrows the remainder at a rate of interest. With futures margin accounts, both parties deposit a required minimum sum of money, but the remainder of the price is not borrowed. This required margin is typically less

[7]The actual amount of money charged and credited depends on the contract size and the number of contracts. A price of £120 might actually refer to a contract that has a standard size of £100,000. Thus, £120 might actually mean 120% of the standard size, or £120,000. In addition, the parties are likely to hold more than one contract. Hence, the gain of £2 referred to in the text might really mean £2,000 (122% minus 120% times the £100,000 standard size) times the number of contracts held by the party.

than 10% of the futures price, which is considerably less than in equity margin trading. In the example above, let us assume that the required margin is £10, which is referred to as the **initial margin**. Both the long and the short put that amount into their respective margin accounts. This money is deposited there to support the trade, not as a form of equity, with the remaining amount borrowed. There is no formal loan created as in equity markets. A futures margin is more of a performance bond or good faith deposit, terms that were previously mentioned. It is simply an amount of money put into an account that covers possible future losses.

Associated with each initial margin is another figure called the **maintenance margin**. The maintenance margin is the amount of money that each participant must maintain in the account after the trade is initiated, and it is always significantly lower than the initial margin. Let us assume that the maintenance margin in this example is £6. If the buyer's account is marked to market with a credit of £2, his margin balance moves to £12, while the seller's account is charged £2 and his balance moves to £8. The clearinghouse then compares each participant's balance with the maintenance margin. At this point, both participants more than meet the maintenance margin.

Let us say, however, that the price continues to move in the long's favor and, therefore, against the short. A few days later, assume that the short's balance falls to £4, which is below the maintenance margin requirement of £6. The short will then get a **margin call**, which is a request to deposit additional funds. The amount that the short has to deposit, however, is *not* the £2 that would bring his balance up to the maintenance margin. Instead, the short must deposit enough funds to bring the balance up to the initial margin. So, the short must come up with £6. The purpose of this rule is to get the party's position significantly above the minimum level and provide some breathing room. If the balance were brought up only to the maintenance level, there would likely be another margin call soon. A party can choose not to deposit additional funds, in which case the party would be required to close out the contract as soon as possible and would be responsible for any additional losses until the position is closed.

As with forward contracts, neither party pays any money to the other when the contract is initiated. Value accrues as the futures price changes, but at the end of each day, the mark-to-market process settles the gains and losses, effectively resetting the value for each party to zero.

The clearinghouse moves money between the participants, crediting gains to the winners and charging losses to the losers. By doing this on a daily basis, the gains and losses are typically quite small, and the margin balances help ensure that the clearinghouse will collect from the party losing money. As an extra precaution, in fast-moving markets, the clearinghouse can make margin calls during the day, not just at the end of the day. Yet there still remains the possibility that a party could default. A large loss could occur quickly and consume the entire margin balance, with additional money owed.[8] If the losing party cannot pay, the clearinghouse provides a guarantee that it will make up the loss, which it does by maintaining an insurance fund. If that fund were depleted, the clearinghouse could levy a tax on the other market participants, though that has never happened.

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[8] For example, let us go back to when the short had a balance of £4, which is £2 below the maintenance margin and £6 below the initial margin. The short will get a margin call, but suppose he elects not to deposit additional funds and requests that his position be terminated. In a fast-moving market, the price might increase more than £4 before his broker can close his position. The remaining balance of £4 would then be depleted, and the short would be responsible for any additional losses.

Some futures contracts contain a provision limiting price changes. These rules, called **price limits**, establish a band relative to the previous day's settlement price, within which all trades must occur. If market participants wish to trade at a price above the upper band, trading stops, which is called **limit up**, until two parties agree on a trade at a price lower than the upper limit. Likewise, if market participants wish to trade at a price below the lower band, which is called **limit down**, no trade can take place until two parties agree to trade at a price above the lower limit. When the market hits these limits and trading stops, it is called **locked limit**. Typically, the exchange rules provide for an expansion of the limits the next day. These price limits, which may be somewhat objectionable to proponents of free markets, are important in helping the clearinghouse manage its credit exposure. Just because two parties wish to trade a futures contract at a price beyond the limits does not mean they should be allowed to do so. The clearinghouse is a third participant in the contract, guaranteeing to each party that it ensures against the other party defaulting. Therefore, the clearinghouse has a vested interest in the price and considerable exposure. Sharply moving prices make it more difficult for the clearinghouse to collect from the parties losing money.

Most participants in futures markets buy and sell contracts, collecting their profits and incurring their losses, with no ultimate intent to make or take delivery of the underlying asset. For example, the long may ultimately sell her position before expiration. When a party re-enters the market at a later date but before expiration and engages in the opposite transaction—a long selling her previously opened contract or a short buying her previously opened contract—the transaction is referred to as an offset. The clearinghouse marks the contract to the current price relative to the previous settlement price and closes out the participant's position.

At any given time, the number of outstanding contracts is called the **open interest**. Each contract counted in the open interest has a long and a corresponding short. The open interest figure changes daily as some parties open up new positions, while other parties offset their old positions. It is theoretically possible that all longs and shorts offset their positions before expiration, leaving no open interest when the contract expires, but in practice there is nearly always some open interest at expiration, at which time there is a final delivery or settlement.

When discussing forward contracts, we noted that a contract could be written such that the parties engage in physical delivery or cash settlement at expiration. In the futures markets, the exchange specifies whether physical delivery or cash settlement applies. In physical delivery contracts, the short is required to deliver the underlying asset at a designated location and the long is required to pay for it. Delivery replaces the mark-to-market process on the final day. It also ensures an important principle that you will use later: *The futures price converges to the spot price at expiration*. Because the short delivers the actual asset and the long pays the current spot price for it, the futures price at expiration has to be the spot price at that time. Alternatively, a futures contract initiated right at the instant of expiration is effectively a spot transaction and, therefore, the futures price at expiration must equal the spot price. Following this logic, in cash settlement contracts, there is a final mark to market, with the futures price formally set to the spot price, thereby ensuring automatic convergence.

In discussing forward contracts, we described the process by which they pay off as the spot price at expiration minus the forward price, $S_T - F_0(T)$, the former determined at expiration and the latter agreed upon when the contract is initiated. Futures contracts basically pay off the same way, but there is a slight difference. Let us say the contract is initiated on Day 0 and expires on Day T. The intervening days are designated Days 1, 2, …, T. The initial futures price is designated $f_0(T)$ and the daily settlement prices on Days 1, 2, …, T are designated $f_1(T), f_2(T), \ldots, f_T(T)$. There are, of course, futures prices within each trading day, but let us focus only on the settlement prices for now. For simplicity, let us assume that the long buys at the settlement price on Day 0 and holds the position all the way to expiration. Through the mark-to-market process, the cash flows to the account of the long will be

$$f_1(T) - f_0(T) \text{ on Day 1}$$
$$f_2(T) - f_1(T) \text{ on Day 2}$$
$$f_3(T) - f_2(T) \text{ on Day 3}$$
$$\ldots$$
$$f_T(T) - f_{T-1}(T) \text{ on Day } T$$

These add up to

$$f_T(T) - f_0(T) \text{ on Day } T.$$

And because of the convergence of the final futures price to the spot price,

$$f_T(T) - f_0(T) = S_T - f_0(T),$$

which is the same as with forward contracts.[9] Note, however, that the timing of these profits is different from that of forwards. Forward contracts realize the full amount, $S_T - f_0(T)$, at expiration, whereas futures contracts realize this amount in parts on a day-to-day basis. Naturally, the time value of money principle says that these are not equivalent amounts of money. But the differences tend to be small, particularly in low-interest-rate environments, some of these amounts are gains and some are losses, and most futures contracts have maturities of less than a year.

But the near equivalence of the profits from a futures and a forward contract disguises an important distinction between these types of contracts. In a forward contact, with the entire payoff made at expiration, a loss by one party can be large enough to trigger a default. Hence, forward contracts are subject to default and require careful consideration of the credit quality of the counterparties. Because futures contracts settle gains and collect losses daily, the amounts that could be lost upon default are much smaller and naturally give the clearinghouse much greater flexibility to manage the credit risk it assumes.

Unlike forward markets, futures markets are highly regulated at the national level. National regulators are required to approve new futures exchanges and even new contracts proposed by existing exchanges as well as changes in margin requirements, price limits, and any significant changes in trading procedures. Violations of futures regulations can be subject to governmental prosecution. In addition, futures markets are far more transparent than forward markets. Futures prices, volume, and open interest are widely reported and easily obtained. Futures prices of nearby expiring contracts are often used as proxies for spot prices, particularly in decentralized spot markets, such as gold, which trades in spot markets all over the world.

In spite of the advantages of futures markets over forward markets, forward markets also have advantages over futures markets. Transparency is not always a good thing. Forward markets offer more privacy and fewer regulatory encumbrances. In addition, forward markets offer more flexibility. With the ability to tailor contracts to the specific needs of participants,

[9] Because of this equivalence, we will not specifically illustrate the profit graphs of futures contracts. You can generally treat them the same as those of forwards, which were shown in Exhibit 1.

forward contracts can be written exactly the way the parties want. In contrast, the standardization of futures contracts makes it more difficult for participants to get exactly what they want, even though they may get close substitutes. Yet, futures markets offer a valuable credit guarantee.

Like forward markets, futures markets can be used for hedging or speculation. For example, a jewelry manufacturer can buy gold futures, thereby hedging the price it will have to pay for one of its key inputs. Although it is more difficult to construct a futures strategy that hedges perfectly than to construct a forward strategy that does so, futures offer the benefit of the credit guarantee. It is not possible to argue that futures are better than forwards or vice versa. Market participants always trade off advantages against disadvantages. Some participants prefer futures, and some prefer forwards. Some prefer one over the other for certain risks and the other for other risks. Some might use one for a particular risk at a point in time and a different instrument for the same risk at another point in time. The choice is a matter of taste and constraints.

The third and final type of forward commitment we will cover is swaps. They go a step further in committing the parties to buy and sell something at a later date: They obligate the parties to a sequence of multiple purchases and sales.

4.1.3. Swaps

The concept of a swap is that two parties exchange (swap) a series of cash flows. One set of cash flows is variable or floating and will be determined by the movement of an underlying asset or rate. The other set of cash flows can be variable and determined by a different underlying asset or rate, or it can be fixed. Formally, a swap is defined as follows:

> *A swap is an over-the-counter derivative contract in which two parties agree to exchange a series of cash flows whereby one party pays a variable series that will be determined by an underlying asset or rate and the other party pays either (1) a variable series determined by a different underlying asset or rate or (2) a fixed series.*

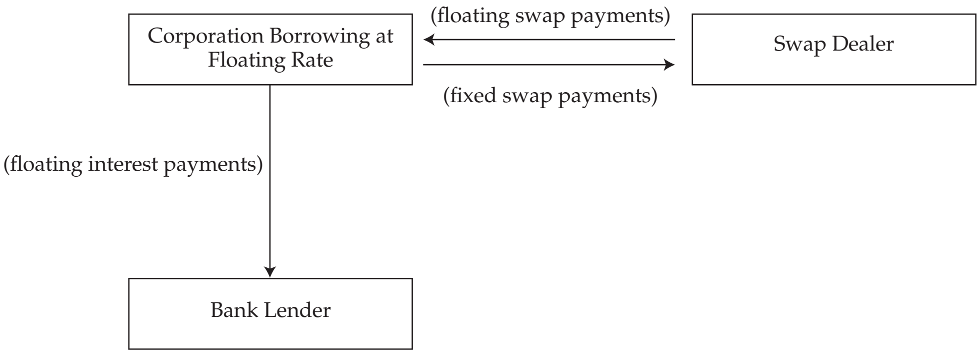
As with forward contracts, swap contracts also contain other terms—such as the identity of the underlying, the relevant payment dates, and the payment procedure—that are negotiated between the parties and written into the contract. A swap is a bit more like a forward contract than a futures contract in that it is an OTC contract, so it is privately negotiated and subject to default. Nonetheless, the similarities between futures and forwards apply to futures and swaps and, indeed, combinations of futures contracts expiring at different dates are often compared to swaps.

As with forward contracts, either party can default but only one party can default at a particular time. The money owed is always based on the net owed by one party to the other. Hence, the party owing the lesser amount cannot default to the party owing the greater amount. Only the latter can default, and the amount it owes is the net of what it owes and what is owed to it, which is also true with forwards.

Swaps are relatively young financial instruments, having been created only in the early 1980s. Thus, it may be somewhat surprising to learn that the swap is the most widely used derivative, a likely result of its simplicity and embracement by the corporate world. The most common swap is the **fixed-for-floating interest rate swap**. In fact, this type of swap is so common that it is often called a "plain vanilla swap" or just a "vanilla swap," owing to the notion that vanilla ice cream is considered plain (albeit tasty).

Let us examine a scenario in which the vanilla interest rate swap is frequently used. Suppose a corporation borrows from a bank at a floating rate. It would prefer a fixed rate, which would enable it to better anticipate its cash flow needs in making its interest payments.[10] The corporation can effectively convert its floating-rate loan to a fixed-rate loan by adding a swap, as shown in Exhibit 2.

EXHIBIT 2 Using an Interest Rate Swap to Convert a Floating-Rate Loan to a Fixed-Rate Loan



The interest payments on the loan are tied to a specific floating rate. For a dollar-based loan, that rate has typically been US dollar Libor.[11] The payments would be based on the rate from the Libor market on a specified reset date times the loan balance times a factor reflecting the number of days in the current interest calculation period. The actual payment is made at a later date. Thus, for a loan balance of, say, $10 million with monthly payments, the rate might be based on Libor on the first business day of the month, with interest payable on the first business day of the next month, which is the next reset date, and calculated as $10 million times the rate times 30/360. The 30/360 convention, an implicit assumption of 30 days in a month, is common but only one of many interest calculation conventions used in the financial world. Often, "30" is replaced by the exact number of days since the last interest payment. The use of a 360-day year is a common assumption in the financial world, which originated in the pre-calculator days when an interest rate could be multiplied by a number like 30/360, 60/360, 90/360, etc., more easily than if 365 were used.

Whatever the terms of the loan are, the terms of the swap are typically set to match those of the loan. Thus, a Libor-based loan with monthly payments based on the 30/360 convention would be matched with a swap with monthly payments based on Libor and the 30/360 convention and the same reset and payment dates. Although the loan has an actual balance (the amount owed by borrower to creditor), the swap does not have such a balance owed by

[10] Banks prefer to make floating-rate loans because their own funding is typically short term and at floating rates. Thus, their borrowing rates reset frequently, giving them a strong incentive to pass that risk on to their customers through floating-rate loans.

[11] Recall that US dollar Libor (London Interbank Offered Rate) is the estimated rate on a dollar-based loan made by one London bank to another. Such a loan takes the form of a time deposit known as a Eurodollar because it represents a dollar deposited in a European bank account. In fact, Libor is the same as the so-called Eurodollar rate. The banks involved can be British banks or British branches of non-British banks. The banks estimate their borrowing rates, and a single average rate is assembled and reported each day. That rate is then commonly used to set the rate on many derivative contracts.

one party to the other. Thus, it has no principal, but it does have a balance of sorts, called the **notional principal**, which ordinarily matches the loan balance. A loan with only one principal payment, the final one, will be matched with a swap with a fixed notional principal. An amortizing loan, which has a declining principal balance, will be matched with a swap with a pre-specified declining notional principal that matches the loan balance.

As with futures and forwards, no money changes hands at the start; thus, the value of a swap when initiated must be zero. The fixed rate on the swap is determined by a process that forces the value to zero, a procedure that will be covered later in the curriculum. As market conditions change, the value of a swap will deviate from zero, being positive to one party and negative to the other.

As with forward contracts, swaps are subject to default, but because the notional amount of a swap is not typically exchanged, the credit risk of a swap is much less than that of a loan.[12] The only money passing from one party to the other is the net difference between the fixed and floating interest payments. In fact, the parties do not even pay each other. Only one party pays the other, as determined by the net of the greater amount owed minus the lesser amount. This does not mean that swaps are not subject to a potentially large amount of credit risk. At a given point in time, one party could default, effectively owing the value of all remaining payments, which could substantially exceed the value that the non-defaulting party owes to the defaulting party. Thus, there is indeed credit risk in a swap. This risk must be managed by careful analysis before the transaction and by the potential use of such risk-mitigating measures as collateral.

There are also interest rate swaps in which one party pays on the basis of one interest rate and the other party pays on the basis of a different interest rate. For example, one party might make payments at Libor, whereas the other might make payments on the basis of the US Treasury bill rate. The difference between Libor and the T-bill rate, often called the TED spread (T-bills versus Eurodollar), is a measure of the credit risk premium of London banks, which have historically borrowed short term at Libor, versus that of the US government, which borrows short term at the T-bill rate. This transaction is called a basis swap. There are also swaps in which the floating rate is set as an average rate over the period, in accordance with the convention for many loans. Some swaps, called overnight indexed swaps, are tied to a Fed funds–type rate, reflecting the rate at which banks borrow overnight. As we will cover later, there are many other different types of swaps that are used for a variety of purposes. The plain vanilla swap is merely the simplest and most widely used.

Because swaps, forwards, and futures are forward commitments, they can all accomplish the same thing. One could create a series of forwards or futures expiring at a set of dates that would serve the same purpose as a swap. Although swaps are better suited for risks that involve multiple payments, at its most fundamental level, a swap is more or less just a series of forwards and, acknowledging the slight differences discussed above, more or less just a series of futures.

[12] It is possible that the notional principal will be exchanged in a currency swap, whereby each party makes a series of payments to the other in different currencies. Whether the notional principal is exchanged depends on the purpose of the swap. This point will be covered later in the curriculum. At this time, you should see that it would be fruitless to exchange notional principals in an interest rate swap because that would mean each party would give the other the same amount of money when the transaction is initiated and re-exchange the same amount of money when the contract terminates.

EXAMPLE 3 Forward Contracts, Futures Contracts, and Swaps

1. Which of the following characterizes forward contracts and swaps but **not** futures?
   A. They are customized.
   B. They are subject to daily price limits.
   C. Their payoffs are received on a daily basis.
2. Which of the following distinguishes forwards from swaps?
   A. Forwards are OTC instruments, whereas swaps are exchange traded.
   B. Forwards are regulated as futures, whereas swaps are regulated as securities.
   C. Swaps have multiple payments, whereas forwards have only a single payment.
3. Which of the following occurs in the daily settlement of futures contracts?
   A. Initial margin deposits are refunded to the two parties.
   B. Gains and losses are reported to other market participants.
   C. Losses are charged to one party and gains credited to the other.

Solution to 1: A is correct. Forwards and swaps are OTC contracts and, therefore, are customized. Futures are exchange traded and, therefore, are standardized. Some futures contracts are subject to daily price limits and their payoffs are received daily, but these characteristics are not true for forwards and swaps.

Solution to 2: C is correct. Forwards and swaps are OTC instruments and both are regulated as such. Neither is regulated as a futures contract or a security. A swap is a series of multiple payments at scheduled dates, whereas a forward has only one payment, made at its expiration date.

Solution to 3: C is correct. Losses and gains are collected and distributed to the respective parties. There is no specific reporting of these gains and losses to anyone else. Initial margin deposits are not refunded and, in fact, additional deposits may be required.

This material completes our introduction to forward commitments. All forward commitments are firm contracts. The parties are required to fulfill the obligations they agreed to. The benefit of this rigidity is that neither party pays anything to the other when the contract is initiated. If one party needs some flexibility, however, it can get it by agreeing to pay the other party some money when the contract is initiated. When the contract expires, the party who paid at the start has some flexibility in deciding whether to buy the underlying asset at the fixed price. Thus, that party did not actually agree to do anything. It had a choice. This is the nature of contingent claims.

4.2. Contingent Claims

A **contingent claim** is a derivative in which the outcome or payoff is dependent on the outcome or payoff of an underlying asset. Although this characteristic is also associated with forward commitments, a contingent claim has come to be associated with a *right*, but not an *obligation*, to make a final payment contingent on the performance of the underlying. Given that the holder of the contingent claim has a choice, the term *contingent claim* has become synonymous with the term *option*. The holder has a choice of whether or not to exercise the option. This choice creates a payoff that transforms the underlying payoff in a more pronounced manner than does a forward, futures, or swap. Those instruments provide linear payoffs: As the underlying goes up (down), the derivative gains (loses). The further up (down) the underlying goes, the more the derivative gains (loses). Options are different in that they limit losses in one direction. In addition, options can pay off as the underlying goes down. Hence, they transform the payoffs of the underlying into something quite different.

4.2.1. Options

We might say that an option, as a contingent claim, grants the right but not the obligation to buy an asset at a later date and at a price agreed on when the option is initiated. But there are so many variations of options that we cannot settle on this statement as a good formal definition. For one thing, options can also grant the right to sell instead of the right to buy. Moreover, they can grant the right to buy or sell earlier than at expiration. So, let us see whether we can combine these points into an all-encompassing definition of an option.

> *An option is a derivative contract in which one party, the buyer, pays a sum of money to the other party, the seller or writer, and receives the right to either buy or sell an underlying asset at a fixed price either on a specific expiration date or at any time prior to the expiration date.*

Unfortunately, even that definition does not cover every unique aspect of options. For example, options can be created in the OTC market and customized to the terms of each party, or they can be created and traded on options exchanges and standardized. As with forward contracts and swaps, customized options are subject to default but are less regulated and relatively transparent. Exchange-traded options are protected against default by the clearinghouse of the options exchange and are relatively transparent and regulated at the national level. As noted in the definition above, options can be terminated early or at their expirations. When an option is terminated, either early or at expiration, the holder of the option chooses whether to exercise it. If he exercises it, he either buys or sells the underlying asset, but he does not have both rights. The right to buy is one type of option, referred to as a **call** or **call option**, whereas the right to sell is another type of option, referred to as a **put** or **put option**. With one very unusual and advanced exception that we do not cover, an option is either a call or a put, and that point is made clear in the contract.

An option is also designated as exercisable early (before expiration) or only at expiration. Options that can be exercised early are referred to as **American-style**. Options that can be exercised only at expiration are referred to as **European-style**. *It is extremely important that you do not associate these terms with where these options are traded*. Both types of options trade on all continents.[13]

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[13] For example, you do not associate French dressing with France. It is widely available and enjoyed worldwide. If you dig deeper into the world of options, you will find Asian options and Bermuda options. Geography is a common source of names for options as well as foods and in no way implies that the option or the food is available only in that geographical location.

As with forwards and futures, an option can be exercised by physical delivery or cash settlement, as written in the contract. For a call option with physical delivery, upon exercise the underlying asset is delivered to the call buyer, who pays the call seller the exercise price. For a put option with physical delivery, upon exercise the put buyer delivers the underlying asset to the put seller and receives the strike price. For a cash settlement option, exercise results in the seller paying the buyer the cash equivalent value as if the asset were delivered and paid for.

The fixed price at which the underlying asset can be purchased is called the **exercise price** (also called the "strike price," the "strike," or the "striking price"). This price is somewhat analogous to the forward price because it represents the price at which the underlying will be purchased or sold if the option is exercised. The forward price, however, is set in the pricing of the contract such that the contract value at the start is zero. The strike price of the option is chosen by the participants. The actual price or value of the option is an altogether different concept.

As noted, the buyer pays the writer a sum of money called the **option premium**, or just the "premium." It represents a fair price of the option, and in a well-functioning market, it would be the value of the option. Consistent with everything we know about finance, it is the present value of the cash flows that are expected to be received by the holder of the option during the life of the option. At this point, we will not get into how this price is determined, but you will learn that later. For now, there are some fundamental concepts you need to understand, which form a basis for understanding how options are priced and why anyone would use an option.

Because the option buyer (the long) does not have to exercise the option, beyond the initial payment of the premium, there is no obligation of the long to the short. Thus, only the short can default, which would occur if the long exercises the option and the short fails to do what it is supposed to do. Thus, in contrast to forwards and swaps, in which either party could default to the other, default in options is possible only from the short to the long.

Ruling out the possibility of default for now, let us examine what happens when an option expires. Using the same notation used previously, let S_T be the price of the underlying at the expiration date, T, and X be the exercise price of the option. Remember that a call option allows the holder, or long, to pay X and receive the underlying. It should be obvious that the long would exercise the option at expiration if S_T is greater than X, meaning that the underlying value is greater than what he would pay to obtain the underlying. Otherwise, he would simply let the option expire. Thus, on the expiration date, the option is described as having a payoff of $Max(0,S_T - X)$. Because the holder of the option would be entitled to exercise it and claim this amount, it also represents the value of the option at expiration. Let us denote that value as c_T. Thus,

$$c_T = Max(0,S_T - X) \qquad \text{(payoff to the call buyer),}$$

which is read as "take the maximum of either zero or $S_T - X$." Thus, if the underlying value exceeds the exercise price ($S_T > X$), then the option value is positive and equal to $S_T - X$. The call option is then said to be **in the money**. If the underlying value is less than the exercise price ($S_T < X$), then $S_T - X$ is negative; zero is greater than a negative number, so the option value would be zero. When the underlying value is less than the exercise price, the call option is said to be **out of the money**. When $S_T = X$, the call option is said to be **at the money**, although at the money is, for all practical purposes, out of the money because the value is still zero.

This payoff amount is also the value of the option at expiration. It represents value because it is what the option is worth at that point. If the holder of the option sells it to someone else an instant before expiration, it should sell for that amount because the new owner would exercise it and capture that amount. To the seller, the value of the option at that point is $-Max(0,S_T - X)$, which is negative to the seller if the option is in the money and zero otherwise.

Using the payoff value and the price paid for the option, we can determine the profit from the strategy, which is denoted with the Greek symbol $\prod$. Let us say the buyer paid c_0 for the option at time 0. Then the profit is

$$\prod = Max(0,S_T - X) - c_0 \qquad \text{(profit to the call buyer),}$$

To the seller, who received the premium at the start, the payoff is

$$-c_T = -Max(0,S_T - X) \qquad \text{(payoff to the call seller),}$$

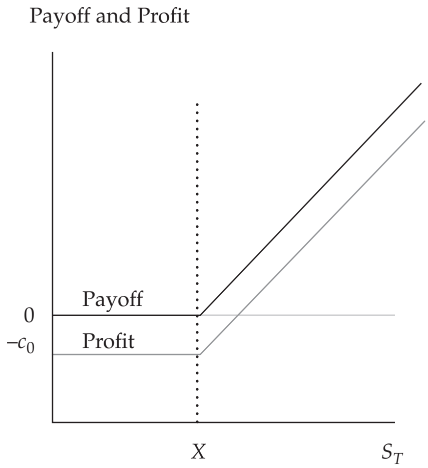
The profit is

$$\prod = -Max(0,S_T - X) + c_0 \qquad \text{(profit to the call seller).}$$

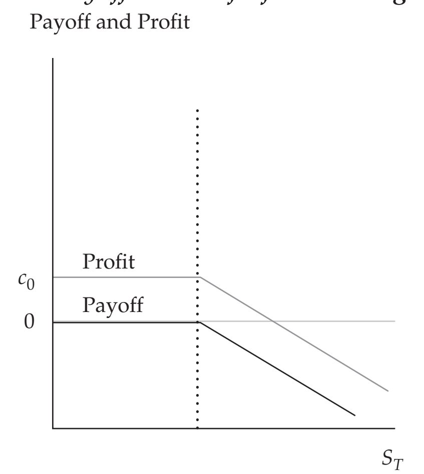
Exhibit 3 illustrates the payoffs and profits to the call buyer and seller as graphical representations of these equations, with the payoff or value at expiration indicated by the dark line and the profit indicated by the light line. Note in Panel A that the buyer has no upper limit on the profit and has a fixed downside loss limit equal to the premium paid for the option. Such a condition, with limited loss and unlimited gain, is a temptation to many unsuspecting investors, but keep in mind that the graph does not indicate the frequency with which gains and losses will occur. Panel B is the mirror image of Panel A and shows that the seller has unlimited losses and limited gains. One might suspect that selling a call is, therefore, the worst investment strategy possible. Indeed, it is a risky strategy, but at this point these are only simple strategies. Other strategies can be added to mitigate the seller's risk to a substantial degree.

EXHIBIT 3 Payoff and Profit from a Call Option

A. Payoff and Profit from Buying



B. Payoff and Profit from Selling



Now let us consider put options. Recall that a put option allows its holder to sell the underlying asset at the exercise price. Thus, the holder should exercise the put at expiration if the underlying asset is worth less than the exercise price ($S_T < X$). In that case, the put is said to be in the money. If the underlying asset is worth the same as the exercise price ($S_T = X$), meaning the put is at the money, or more than the exercise price ($S_T > X$), meaning the put is out of the money, the option holder would not exercise it and it would expire with zero value. Thus, the payoff to the put holder is

$$p_T = Max(0, X - S_T) \qquad \text{(payoff to the put buyer),}$$

If the put buyer paid p_0 for the put at time 0, the profit is

$$\Pi = Max(0, X - S_T) - p_0 \qquad \text{(profit to the put buyer),}$$

And for the seller, the payoff is

$$-p_T = -Max(0, X - S_T) \qquad \text{(payoff to the put seller),}$$

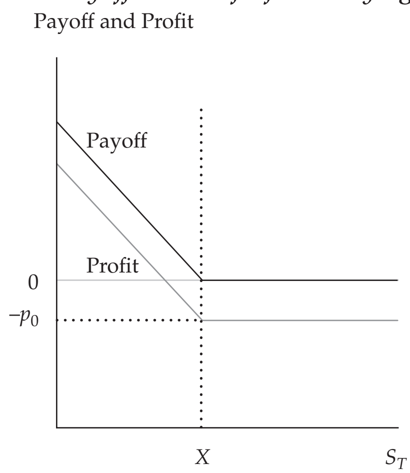
And the profit is

$$\Pi = -Max(0, X - S_T) + p_0 \qquad \text{(profit to the put seller).}$$

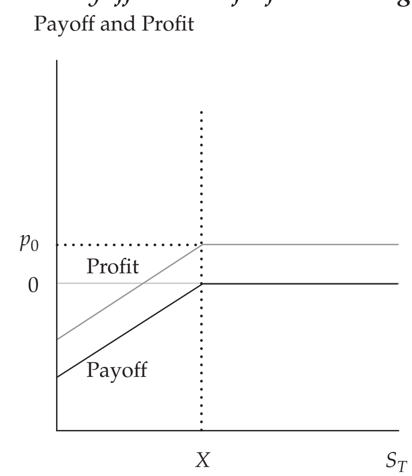
Exhibit 4 illustrates the payoffs and profits to the buyer and seller of a put.

EXHIBIT 4 Payoff and Profit from a Put Option

A. Payoff and Profit from Buying



B. Payoff and Profit from Selling



The put buyer has a limited loss, and although the gain is limited by the fact that the underlying value cannot go below zero, the put buyer does gain more the lower the value of the underlying. In this manner, we see how a put option is like insurance. Bad outcomes for the underlying trigger a payoff for both the insurance policy and the put, whereas good outcomes result only in loss of the premium. The put seller, like the insurer, has a limited gain and a loss that is larger the lower the value of the underlying. As with call options, these graphs must be considered carefully because they do not indicate the frequency with which gains and losses will occur. At this point, it should be apparent that buying a call option is consistent with a bullish point of view and buying a put option is consistent with a bearish point of view. Moreover, in contrast to forward commitments, which have payoffs that are linearly related to the payoffs of the underlying (note the straight lines in Exhibit 1), contingent claims have payoffs that are non-linear in relation to the underlying. There is linearity over a range—say, from 0 to X or from X upward or downward—but over the entire range of values for the underlying, the payoffs of contingent claims cannot be depicted with a single straight line.

We have seen only a snapshot of the payoff and profit graphs that can be created with options. Calls can be combined with puts, the underlying asset, and other calls or puts with different expirations and exercise prices to create a diverse set of payoff and profit graphs, some of which are covered later in the curriculum.

Before leaving options, let us again contrast the differences between options and forward commitments. With forward commitments, the parties agree to trade an underlying asset at a later date and at a price agreed upon when the contract is initiated. Neither party pays any cash to the other at the start. With options, the buyer pays cash to the seller at the start and receives the right, but not the obligation, to buy (if a call) or sell (if a put) the underlying asset at expiration at a price agreed upon (the exercise price) when the contract is initiated. In contrast to forwards, futures, and swaps, options do have value at the start: the premium paid by buyer to seller. That premium pays for the *right*, eliminating the *obligation*, to trade the underlying at a later date, as would be the case with a forward commitment.

Although there are numerous variations of options, most have the same essential features described here. There is, however, a distinctive family of contingent claims that emerged in the early 1990s and became widely used and, in some cases, heavily criticized. These instruments are known as credit derivatives.

4.2.2. Credit Derivatives

Credit risk is surely one of the oldest risks known to mankind. Human beings have been lending things to each other for thousands of years, and even the most primitive human beings must have recognized the risk of lending some of their possessions to their comrades. Until the last 20 years or so, however, the management of credit risk was restricted to simply doing the best analysis possible before making a loan, monitoring the financial condition of the borrower during the loan, limiting the exposure to a given party, and requiring collateral. Some modest forms of insurance against credit risk have existed for a number of years, but insurance can be a slow and cumbersome way of protecting against credit loss. Insurance is typically highly regulated, and insurance laws are usually very consumer oriented. Thus, credit insurance as a financial product has met with only modest success.

In the early 1990s, however, the development of the swaps market led to the creation of derivatives that would hedge credit risk. These instruments came to be known as **credit derivatives**, and they avoided many of the regulatory constraints of the traditional insurance industry. Here is a formal definition:

> *A credit derivative is a class of derivative contracts between two parties, a credit protection buyer and a credit protection seller, in which the latter provides protection to the former against a specific credit loss.*

One of the first credit derivatives was a **total return swap**, in which the underlying is typically a bond or loan, in contrast to, say, a stock or stock index. The credit protection buyer offers to pay the credit protection seller the total return on the underlying bond. This total return consists of all interest and principal paid by the borrower plus any changes in the bond's market value. In return, the credit protection seller typically pays the credit protection buyer either a fixed or a floating rate of interest. Thus, if the bond defaults, the credit protection seller must continue to make its promised payments, while receiving a very small return or virtually no return from the credit protection buyer. If the bond incurs a loss, as it surely will if it defaults, the credit protection seller effectively pays the credit protection buyer.

Another type of credit derivative is the **credit spread option**, in which the underlying is the credit (yield) spread on a bond, which is the difference between the bond's yield and the yield on a benchmark default-free bond. As you will learn in the fixed-income material, the credit spread is a reflection of investors' perception of credit risk. Because a credit spread option requires a credit spread as the underlying, this type of derivative works only with a traded bond that has a quoted price. The credit protection buyer selects the strike spread it desires and pays the option premium to the credit protection seller. At expiration, the parties determine whether the option is in the money by comparing the bond's yield spread with the strike chosen, and if it is, the credit protection seller pays the credit protection buyer the established payoff. Thus, this instrument is essentially a call option in which the underlying is the credit spread.

A third type of credit derivative is the **credit-linked note (CLN)**. With this derivative, the credit protection buyer holds a bond or loan that is subject to default risk (the underlying reference security) and issues its own security (the credit-linked note) with the condition that if the bond or loan it holds defaults, the principal payoff on the credit-linked note is reduced accordingly. Thus, the buyer of the credit-linked note effectively insures the credit risk of the underlying reference security.

These three types of credit derivatives have had limited success compared with the fourth type of credit derivative, the **credit default swap (CDS)**. The credit default swap, in particular, has achieved much success by capturing many of the essential features of insurance while avoiding the high degree of consumer regulations that are typically associated with traditional insurance products.

In a CDS, one party—the credit protection buyer, who is seeking credit protection against a third party—makes a series of regularly scheduled payments to the other party, the credit protection seller. The seller makes no payments until a credit event occurs. A declaration of bankruptcy is clearly a credit event, but there are other types of credit events, such as a failure to make a scheduled payment or an involuntary restructuring. The CDS contract specifies what constitutes a credit event, and the industry has a procedure for declaring credit events, though that does not guarantee the parties will not end up in court arguing over whether something was or was not a credit event.

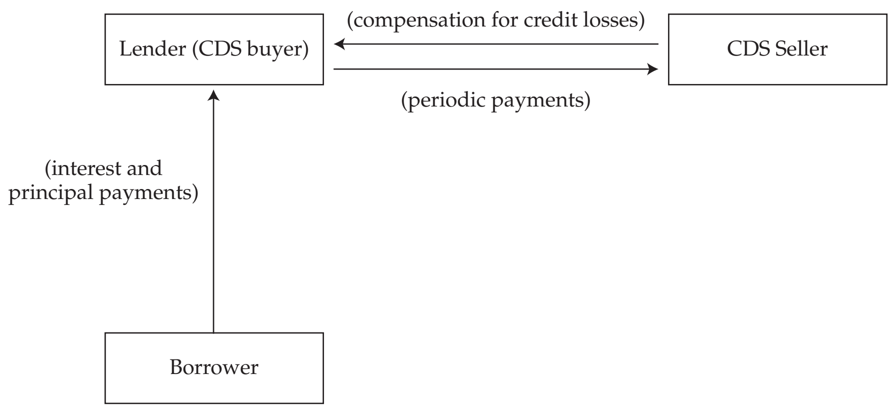
Formally, a credit default swap is defined as follows:

> *A credit default swap is a derivative contract between two parties, a credit protection buyer and a credit protection seller, in which the buyer makes a series of cash payments to the seller and receives a promise of compensation for credit losses resulting from the default of a third party.*

A CDS is conceptually a form of insurance. Sellers of CDSs, oftentimes banks or insurance companies, collect periodic payments and are required to pay out if a loss occurs from the default of a third party. These payouts could take the form of restitution of the defaulted amount or the party holding the defaulting asset could turn it over to the CDS seller and receive a fixed amount. The most common approach is for the payout to be determined by an auction to estimate the market value of the defaulting debt. Thus, CDSs effectively provide coverage against a loss in return for the protection buyer paying a premium to the protection seller, thereby taking the form of insurance against credit loss. Although insurance contracts have certain legal characteristics that are not found in credit default swaps, the two instruments serve similar purposes and operate in virtually the same way: payments made by one party in return for a promise to cover losses incurred by the other.

Exhibit 5 illustrates the typical use of a CDS by a lender. The lender is exposed to the risk of non-payment of principal and interest. The lender lays off this risk by purchasing a CDS from a CDS seller. The lender—now the CDS buyer—promises to make a series of periodic payments to the CDS seller, who then stands ready to compensate the CDS buyer for credit losses.

EXHIBIT 5 Using a Credit Default Swap to Hedge the Credit Risk of a Loan



Clearly, the CDS seller is betting on the borrower's not defaulting or—more generally, as insurance companies operate—that the total payouts it is responsible for are less than the total payments collected. Of course, most insurance companies are able to do this by having reliable actuarial statistics, diversifying their risk, and selling some of the risk to other insurance companies. Actuarial statistics are typically quite solid. Average claims for life, health, and casualty insurance are well documented, and insurers can normally set premiums to cover losses and operate at a reasonable profit. Although insurance companies try to manage some of their risks at the micro level (e.g., charging smokers more for life and health insurance), most of their risk management is at the macro level, wherein they attempt to make sure their risks are not concentrated. Thus, they avoid selling too much homeowners insurance to individuals in tornado-prone areas. If they have such an exposure, they can use the reinsurance market to sell some of the risk to other companies that are not overexposed to that risk. Insurance companies attempt to diversify their risks and rely on the principle of uncorrelated risks, which plays such an important role in portfolio management. A well-diversified insurance company, like a well-diversified portfolio, should be able to earn a return commensurate with its assumed risk in the long run.

Credit default swaps should operate the same way. Sellers of CDSs should recognize when their credit risk is too concentrated. When that happens, they become buyers of CDSs from other parties or find other ways to lay off the risk. Unfortunately, during the financial crisis that began in 2007, many sellers of CDSs failed to recognize the high correlations among borrowers whose debt they had guaranteed. One well-known CDS seller, AIG, is a large and highly successful traditional insurance company that got into the business of selling CDSs. Many of these CDSs insured against mortgages. With the growth of the subprime mortgage market, many of these CDS-insured mortgages had a substantial amount of credit risk and were often poorly documented. AIG and many other CDS sellers were thus highly exposed to systemic credit contagion, a situation in which defaults in one area of an economy ripple into another, accompanied by bank weaknesses and failures, rapidly falling equity markets, rising credit risk premiums, and a general loss of confidence in the financial system and the economy. These presumably well-diversified risks guaranteed by CDS sellers, operating as though they were insurance companies, ultimately proved to be poorly diversified. Systemic financial risks can spread more rapidly than fire, health, and casualty risks. Virtually no other risks, except those originating from wars or epidemics, spread in the manner of systemic financial risks.

Thus, to understand and appreciate the importance of the CDS market, it is necessary to recognize how that market can fail. The ability to separate and trade risks is a valuable one. Banks can continue to make loans to their customers, thereby satisfying the customers' needs, while laying off the risk elsewhere. In short, parties not wanting to bear certain risks can sell them to parties wanting to assume certain risks. If all parties do their jobs correctly, the markets and the economy work more efficiently. If, as in the case of certain CDS sellers, not everyone does a good job of managing risk, there can be serious repercussions. In the case of AIG and some other companies, taxpayer bailouts were the ultimate price paid to keep these large institutions afloat so that they could continue to provide their other critical services to consumers. The rules proposed in the new OTC derivatives market regulations—which call for greater regulation and transparency of OTC derivatives and, in particular, CDSs—have important implications for the future of this market and these instruments.

EXAMPLE 4 Options and Credit Derivatives

1. An option provides which of the following?
   A. Either the right to buy or the right to sell an underlying
   B. The right to buy and sell, with the choice made at expiration
   C. The obligation to buy or sell, which can be converted into the right to buy or sell
2. Which of the following is **not** a characteristic of a call option on a stock?
   A. A guarantee that the stock will increase
   B. A specified date on which the right to buy expires
   C. A fixed price at which the call holder can buy the stock
3. A credit derivative is which of the following?
   A. A derivative in which the premium is obtained on credit
   B. A derivative in which the payoff is borrowed by the seller
   C. A derivative in which the seller provides protection to the buyer against credit loss from a third party

Solution to 1: A is correct. An option is strictly the right to buy (a call) or the right to sell (a put). It does not provide both choices or the right to convert an obligation into a right.

Solution to 2: A is correct. A call option on a stock provides no guarantee of any change in the stock price. It has an expiration date, and it provides for a fixed price at which the holder can exercise the option, thereby purchasing the stock.

Solution to 3: C is correct. Credit derivatives provide a guarantee against loss caused by a third party's default. They do not involve borrowing the premium or the payoff.

4.2.3. Asset-Backed Securities

Although these instruments are covered in more detail in the fixed-income material, we would be remiss if we failed to include them with derivatives. But we will give them only light coverage here.

As discussed earlier, derivatives take (derive) their value from the value of the underlying, as do mutual funds and exchange-traded funds (ETFs). A mutual fund or an ETF holding bonds is virtually identical to the investor holding the bonds directly. Asset-backed securities (ABSs) take this concept a step further by altering the payment streams. ABSs typically divide the payments into slices, called tranches, in which the priority of claims has been changed from equivalent to preferential. For example, in a bond mutual fund or an ETF, all investors in the fund have equal claims, and so the rate of return earned by each investor is exactly the same. If a portfolio of the same bonds were assembled into an ABS, some investors in the ABS would have claims that would supersede those of other investors. The differential nature of these claims becomes relevant when either prepayments or defaults occur.

Prepayments mostly affect only mortgages. When a portfolio of mortgages is assembled into an ABS, the resulting instrument is called a **collateralized mortgage obligation** (CMO). Commonly but not always, the credit risk has been reduced or eliminated, perhaps by a CDS, as discussed earlier. When homeowners pay off their mortgages early due to refinancing at lower rates, the holders of the mortgages suffer losses. They expected to receive a stream of returns that is now terminated. The funds that were previously earning a particular rate will now have to be invested to earn a lower rate. These losses are the mirror images of the gains homeowners make when they proudly proclaim that they refinanced their mortgages and substantially lowered their payments.

CMOs partition the claims against these mortgages into different tranches, which are typically called A, B, and C. Class C tranches bear the first wave of prepayments until that tranche has been completely repaid its full principal investment. At that point, the Class B tranche holders bear the next prepayments until they have been fully repaid. The Class A tranche holders then bear the next wave of prepayments.[14] Thus, the risk faced by the various tranche holders is different from that of a mutual fund or ETF, which would pass the returns directly through

[14] The reference to only three tranches is just a general statement. There are many more types of tranches. Our discussion of the three classes is for illustrative purposes only and serves to emphasize that there are high-priority claims, low-priority claims, and other claims somewhere in the middle.

such that investors would all receive the same rates of return. Therefore, the expected returns of CMO tranches vary and are commensurate with the prepayment risk they assume. Some CMOs are also characterized by credit risk, perhaps a substantial amount, from subprime mortgages.

When bonds or loans are assembled into ABSs, they are typically called **collateralized bond obligations** (CBOs) or **collateralized loan obligations** (CLOs). These instruments (known collectively as **collateralized debt obligations**, or CDOs) do not traditionally have much prepayment risk but they do have credit risk and oftentimes a great deal of it. The CDO structure allocates this risk to tranches that are called senior, mezzanine, or junior tranches (the last sometimes called equity tranches). When defaults occur, the junior tranches bear the risk first, followed by the mezzanine tranches, and then the senior tranches. The expected returns of the tranches vary according to the perceived credit risk, with the senior tranches having the highest credit quality and the junior the lowest. Thus, the senior tranches have the lowest expected returns and the junior tranches have the highest.

An asset-backed security is formally defined as follows:

An asset-backed security is a derivative contract in which a portfolio of debt instruments is assembled and claims are issued on the portfolio in the form of tranches, which have different priorities of claims on the payments made by the debt securities such that prepayments or credit losses are allocated to the most-junior tranches first and the most-senior tranches last.

ABSs seem to have only an indirect and subtle resemblance to options, but they are indeed options. They promise to make a series of returns that are typically steady. These returns can be lowered if prepayments or defaults occur. Thus, they are contingent on prepayments and defaults. Take a look again at Exhibit 4, Panel B (the profit and payoff of a short put option). If all goes well, there is a fixed return. If something goes badly, the return can be lowered, and the worse the outcome, the lower the return. Thus, holders of ABSs have effectively written put options.

This completes the discussion of contingent claims. Having now covered forward commitments and contingent claims, the final category of derivative instruments is more or less just a catch-all category in case something was missed.

4.3. Hybrids

The instruments just covered encompass all the fundamental instruments that exist in the derivatives world. Yet, the derivatives world is truly much larger than implied by what has been covered here. We have not covered and will touch only lightly on the many hybrid instruments that combine derivatives, fixed-income securities, currencies, equities, and commodities. For example, options can be combined with bonds to form either callable bonds or convertible bonds. Swaps can be combined with options to form swap payments that have upper and lower limits. Options can be combined with futures to obtain options on futures. Options can be created with swaps as the underlying to form swaptions. Some of these instruments will be covered later. For now, you should just recognize that the possibilities are almost endless.

We will not address these hybrids directly, but some are covered elsewhere in the curriculum. The purpose of discussing them here is for you to realize that derivatives create possibilities not otherwise available in their absence. This point will lead to a better understanding of why derivatives exist, a topic we will get to very shortly.

EXAMPLE 5 Forward Commitments versus Contingent Claims

1. Which of the following is **not** a forward commitment?
   A. An agreement to take out a loan at a future date at a specific rate
   B. An offer of employment that must be accepted or rejected in two weeks
   C. An agreement to lease a piece of machinery for one year with a series of fixed monthly payments
2. Which of the following statements is true about contingent claims?
   A. Either party can default to the other.
   B. The payoffs are linearly related to the performance of the underlying.
   C. The most the long can lose is the amount paid for the contingent claim.

Solution to 1: B is correct. Both A and C are commitments to engage in transactions at future dates. In fact, C is like a swap because the party agrees to make a series of future payments and in return receives temporary use of an asset whose value could vary. B is a contingent claim. The party receiving the employment offer can accept it or reject it if there is a better alternative.

Solution to 2: C is correct. The maximum loss to the long is the premium. The payoffs of contingent claims are not linearly related to the underlying, and only one party, the short, can default.

4.4. Derivatives Underlyings

Before discussing the purposes and benefits of derivatives, we need to clarify some points that have been implied so far. We have alluded to certain underlying assets, this section will briefly discuss the underlyings more directly.

4.4.1. Equities

Equities are one of the most popular categories of underlyings on which derivatives are created. There are two types of equities on which derivatives exist: individual stocks and stock indices. Derivatives on individual stocks are primarily options. Forwards, futures, and swaps on individual stocks are not widely used. Index derivatives in the form of options, forwards, futures, and swaps are very popular. Index swaps, more often called equity swaps, are quite popular and permit investors to pay the return on one stock index and receive the return on another index or a fixed rate. They can be very useful in asset allocation strategies by allowing an equity manager to increase or reduce exposure to an equity market or sector without trading the individual securities.

In addition, options on stocks are frequently used by companies as compensation and incentives for their executives and employees. These options are granted to provide incentives to work toward driving the stock price up and can result in companies paying lower cash compensation.[15] Some companies also issue warrants, which are options sold to the public that allow the holders to exercise them and buy shares directly from the companies.[16]

4.4.2. Fixed-Income Instruments and Interest Rates

Options, forwards, futures, and swaps on bonds are widely used. The problem with creating derivatives on bonds, however, is that there are almost always many issues of bonds. A single issuer, whether it is a government or a private borrower, often has more than one bond issue outstanding. For futures contracts, with their standardization requirements, this problem is particularly challenging. What does it mean to say that a futures contract is on a German bund, a US Treasury note, or a UK gilt? The most common solution to this problem is to allow multiple issues to be delivered on a single futures contract. This feature adds some interesting twists to the pricing and trading strategies of these instruments.

Until now, we have referred to the underlying as an *asset*. Yet, one of the largest derivative underlyings is not an asset. It is simply an interest rate. An interest rate is not an asset. One cannot hold an interest rate or place it on a balance sheet as an asset. Although one can hold an instrument that pays an interest rate, the rate itself is not an asset. But there are derivatives in which the rate, not the instrument that pays the rate, is the underlying. In fact, we have already covered one of these derivatives: The plain vanilla interest rate swap in which Libor is the underlying.[17] Instead of a swap, an interest rate derivative could be an option. For example, a call option on 90-day Libor with a strike of 5% would pay off if at expiration Libor exceeds 5%. If Libor is below 5%, the option simply expires unexercised.

Interest rate derivatives are the most widely used derivatives. With that in mind, we will be careful in using the expression *underlying asset* and will use the more generic *underlying*.

4.4.3. Currencies

Currency risk is a major factor in global financial markets, and the currency derivatives market is extremely large. Options, forwards, futures, and swaps are widely used. Currency derivatives can be complex, sometimes combining elements of other underlyings. For example, a currency swap involves two parties making a series of interest rate payments to each other in different currencies. Because interest rates and currencies are both subject to change, a currency swap has two sources of risk. Although this instrument may sound extremely complicated, it merely reflects the fact that companies operating across borders are subject to both interest rate risk and currency risk and currency swaps are commonly used to manage those risks.

[15] Unfortunately, the industry has created some confusion with the terminology of these instruments. They are often referred to as *stock options*, and yet ordinary publicly traded options not granted to employees are sometimes referred to as stock options. The latter are also sometimes called *equity options*, whereas employee-granted options are almost never referred to as equity options. If the terms *executive stock options* and *employee stock options* were always used, there would be no problem. You should be aware of and careful about this confusion.

[16] A warrant is a type of option, similar to the employee stock option, written by the company on its own stock, in contrast to exchange-traded and OTC options, in which the company is not a party to the option contract. Also note that, unfortunately, the financial world uses the term *warrant* to refer to a number of other option-like instruments. Like a lot of words that have multiple meanings, one must understand the context to avoid confusion.

[17] As you will see later, there are also futures in which the underlying is an interest rate (Eurodollar futures) and forwards in which the underlying is an interest rate (forward rate agreements, or FRAs).

4.4.4. Commodities

Commodities are resources, such as food, oil, and metals, that humans use to sustain life and support economic activity. Because of the economic principle of comparative advantage, countries often specialize in the production of certain resources. Thus, the commodities market is extremely large and subject to an almost unimaginable array of risks. One need only observe how the price of oil moves up as tension builds in the Middle East or how the price of orange juice rises on a forecast of cold weather in Florida.

Commodity derivatives are widely used to speculate in and manage the risk associated with commodity price movements. The primary commodity derivatives are futures, but forwards, swaps, and options are also used. The reason that futures are in the lead in the world of commodities is simply history. The first futures markets were futures on commodities. The first futures exchange, the Chicago Board of Trade, was created in 1848, and until the creation of currency futures in 1972, there were no futures on any underlying except commodities.

There has been a tendency to think of the commodities world as somewhat separate from the financial world. Commodity traders and financial traders were quite different groups. Since the creation of financial futures, however, commodity and financial traders have become relatively homogeneous. Moreover, commodities are increasingly viewed as an important asset class that should be included in investment strategies because of their ability to help diversify portfolios.

4.4.5. Credit

As we previously discussed, credit is another underlying and quite obviously not an asset. Credit default swaps (CDSs) and collateralized debt obligations (CDOs) were discussed extensively in an earlier section. These instruments have clearly established that credit is a distinct underlying that has widespread interest from a trading and risk management perspective. In addition, to the credit of a single entity, credit derivatives are created on multiple entities. CDOs themselves are credit derivatives on portfolios of credit risks. In recent years, indices of CDOs have been created, and instruments based on the payoffs of these CDO indices are widely traded.

4.4.6. Other

This category is included here to capture some of the really unusual underlyings. One in particular is weather. Although weather is hardly an asset, it is certainly a major force in how some entities perform. For example, a ski resort needs snow, farmers need an adequate but not excessive amount of rain, and public utilities experience strains on their capacity during temperature extremes. Derivatives exist in which the payoffs are measured as snowfall, rainfall, and temperature. Although these derivatives have not been widely used—because of some complexities in pricing, among other things—they continue to exist and may still have a future. In addition, there are derivatives on electricity, which is also not an asset. It cannot be held in the traditional sense because it is created and consumed almost instantaneously. Another unusual type of derivative is based on disasters in the form of insurance claims.

Financial institutions will continue to create derivatives on all types of risks and exposures. Most of these derivatives will fail because of little trading interest, but a few will succeed. If that speaks badly of derivatives, it must be remembered that most small businesses fail, most creative ideas fail, and most people who try to become professional entertainers or athletes fail. It is the sign of a healthy and competitive system that only the very best survive.

The Size of the Derivatives Market

In case anyone thinks that the derivatives market is not large enough to justify studying, we should consider how big the market is. Unfortunately, gauging the size of the derivatives market is not a simple task. OTC derivatives contracts are private transactions. No reporting agency gathers data, and market size is not measured in traditional volume-based metrics, such as shares traded in the stock market. Complicating things further is the fact that derivatives underlyings include equities, fixed-income securities, interest rates, currencies, commodities, and a variety of other underlyings. All these underlyings have their own units of measurement. Hence, measuring how "big" the underlying derivatives markets are is like trying to measure how much fruit consumers purchase; the proverbial mixing of apples, oranges, bananas, and all other fruits.

The exchange-listed derivatives market reports its size in terms of volume, meaning the number of contracts traded. Exchange-listed volume, however, is an inconsistent number. For example, US Treasury bond futures contracts trade in units covering \$100,000 face value. Eurodollar futures contracts trade in units covering \$1,000,000 face value. Crude oil trades in 1,000-barrel (42 gallons each) units. Yet, one traded contract of each gets equal weighting in volume totals.

The March–April issue of the magazine *Futures Industry* (available to subscribers) reports the annual volume of the entire global futures and options industry. For 2011, that volume was more than 25 billion contracts.

OTC volume is even more difficult to measure. There is no count of the number of contracts that trade. In fact, *volume* is an almost meaningless concept in OTC markets because any notion of volume requires a standardized size. If a customer goes to a swaps dealer and enters into a swap to hedge a \$50 million loan, there is no measure of how much volume that transaction generated. The \$50 million swap's notional principal, however, does provide a measure to some extent. Forwards, swaps, and OTC options all have notional principals, so they can be measured in that manner. Another measure of the size of the derivatives market is the market value of these contracts. As noted, forwards and swaps start with zero market value, but their market value changes as market conditions change. Options do not start with zero market value and almost always have a positive market value until expiration, when some options expire out of the money.

The OTC industry has taken both of these concepts—notional principal and market value—as measures of the size of the market. Notional principal is probably a more accurate measure. The amount of a contract's notional principal is unambiguous: It is written into the contract and the two parties cannot disagree over it. Yet, notional principal terribly overstates the amount of money actually at risk. For example, a \$50 million notional principal swap will have nowhere near \$50 million at risk. The payments on such a swap are merely the net of two opposite series of interest payments on \$50 million. The market value of such a swap is the present value of one stream of payments minus the present value of the other. This market value figure will always be well below the notional principal. Thus, market value seems like a better measure except that, unlike notional principal, it is not unambiguous. Market value requires measurement, and two parties can disagree on the market value of the same transaction.

Notional principal and market value estimates for the global OTC derivatives market are collected semi-annually by the Bank for International Settlements of Basel, Switzerland, and published on its website (http://www.bis.org/statistics/derstats.htm). At the end of 2011, notional principal was more than $600 trillion and market value was about $27 trillion. A figure of $600 trillion is an almost unfathomable number and, as noted, is a misleading measure of the amount of money at risk.[18] The market value figure of $27 trillion is a much more realistic measure, but as noted, it is less accurate, relying on estimates provided by banks.

Hence, the exchange-listed and OTC markets use different measures and each of those measures is subject to severe limitations. About all we can truly say for sure about the derivatives market is, "It is big."

5. THE PURPOSES AND BENEFITS OF DERIVATIVES

Economic historians know that derivatives markets have existed since at least the Middle Ages. It is unclear whether derivatives originated in the Asian rice markets or possibly in medieval trade fairs in Europe. We do know that the origin of modern futures markets is the creation of the Chicago Board of Trade in 1848. To understand why derivatives markets exist, it is useful to take a brief look at why the Chicago Board of Trade was formed.

In the middle of the 19th century, midwestern America was rapidly becoming the center of agricultural production in the United States. At the same time, Chicago was evolving into a major American city, a hub of transportation and commerce. Grain markets in Chicago were the central location to which midwestern farmers brought their wheat, corn, and soybeans to sell. Unfortunately, most of these products arrived at approximately the same time of the year, September through November. The storage facilities in Chicago were strained beyond capacity. As a result, prices would fall tremendously and some farmers reportedly found it more economical to dump their grains in the Chicago River rather than transport them back to the farm. At other times of the year, prices would rise steeply. A group of businessmen saw this situation as unnecessary volatility and a waste of valuable produce. To deal with this problem, they created the Chicago Board of Trade and a financial instrument called the "to-arrive" contract. A farmer could sell a to-arrive contract at any time during the year. This contract fixed the price of the farmer's grain on the basis of delivery in Chicago at a specified later date. Grain is highly storable, so farmers can hold on to the grain and deliver it at almost any later time. This plan substantially reduced seasonal market volatility and made the markets work much better for all parties.

The traders in Chicago began to trade these contracts, speculating on movements in grain prices. Soon, it became apparent that an important and fascinating market had developed. Widespread hedging and speculative interest resulted in substantial market growth, and about 80 years later, a clearinghouse and a performance guarantee were added, thus completing the evolution of the to-arrive contract into today's modern futures contract.

Many commodities and all financial assets that underlie derivatives contracts are not seasonally produced. Hence, this initial motivation for futures markets is only a minor advantage of derivatives markets today. But there are many reasons why derivative markets serve an important and useful purpose in contemporary finance.

[18]To put it in perspective, it would take 19 million years for a clock to tick off 600 trillion seconds!

5.1. Risk Allocation, Transfer, and Management

Until the advent of derivatives markets, risk management was quite cumbersome. Setting the actual level of risk to the desired level of risk required engaging in transactions in the underlyings. Such transactions typically had high transaction costs and were disruptive of portfolios. In many cases, it is quite difficult to fine-tune the level of risk to the desired level. From the perspective of a risk taker, it was quite costly to buy risk because a large amount of capital would be required.

Derivatives solve these problems in a very effective way: They allow trading the risk without trading the instrument itself. For example, consider a stockholder who wants to reduce exposure to a stock. In the pre-derivatives era, the only way to do so was to sell the stock. Now, the stockholder can sell futures, forwards, calls, or swaps, or buy put options, all while retaining the stock. For a company founder, these types of strategies can be particularly useful because the founder can retain ownership and probably board membership. Many other excellent examples of the use of derivatives to transfer risk are covered elsewhere in the curriculum. The objective at this point is to establish that derivatives provide an effective method of transferring risk from parties who do not want the risk to parties who do. In this sense, risk allocation is improved within markets and, indeed, the entire global economy.

The overall purpose of derivatives is to obtain more effective risk management within companies and the entire economy. Although some argue that derivatives do not serve this purpose very well (we will discuss this point in Section 6), for now you should understand that derivatives can improve the allocation of risk and facilitate more effective risk management for both companies and economies.

5.2. Information Discovery

One of the advantages of futures markets has been described as *price discovery*. A futures price has been characterized by some experts as a revelation of some information about the future. Thus, a futures price is sometimes thought of as predictive. This statement is not strictly correct because futures prices are not really forecasts of future spot prices. They provide only a little more information than do spot prices, but they do so in a very efficient manner. The markets for some underlyings are highly decentralized and not very efficient. For example, what is gold worth? It trades in markets around the world, but probably the best place to look is at the gold futures contract expiring soonest. What is the value of the S&P 500 Index when the US markets are not open? As it turns out, US futures markets open before the US stock market opens. The S&P 500 futures price is frequently viewed as an indication of where the stock market will open.

Derivative markets can, however, convey information not impounded in spot markets. By virtue of the fact that derivative markets require less capital, information can flow into the derivative markets before it gets into the spot market. The difference may well be only a matter of minutes or possibly seconds, but it can provide the edge to astute traders.

Finally, we should note that futures markets convey another simple piece of information: What price would one accept to avoid uncertainty? If you hold a stock worth \$40 and could hedge the next 12 months' uncertainty, what locked-in price should you expect to earn? As it turns out, it should be the price that guarantees the risk-free rate minus whatever dividends would be paid on the stock. Derivatives—specifically, futures, forwards, and swaps—reveal the price that the holder of an asset could take and avoid the risk.

What we have said until now applies to futures, forwards, and swaps. What about options? As you will learn later, given the underlying and the type of option (call or put), an option price reflects two characteristics of the option (exercise price and time to expiration), three characteristics of the underlying (price, volatility, and cash flows it might pay), and one general macroeconomic factor (risk-free rate). Only one of these factors, volatility, is not relatively easy to identify. But with the available models to price the option, we can infer what volatility people are using from the actual market prices at which they execute trades. That volatility, called **implied volatility**, measures the expected risk of the underlying. It reflects the volatility that investors use to determine the market price of the option. Knowing the expected risk of the underlying asset is an extremely useful piece of information. In fact, for options on broad-based market indices, such as the S&P 500, the implied volatility is a good measure of the general level of uncertainty in the market. Some experts have even called it a measure of fear. Thus, options provide information about what investors think of the uncertainty in the market, if not their fear of it.[19]

In addition, options allow the creation of trading strategies that cannot be done by using the underlying. As the exhibits on options explained, these strategies provide asymmetrical performance: limited movement in one direction and movement in the other direction that changes with movements in the underlying.

5.3. Operational Advantages

We noted earlier that derivatives have lower transaction costs than the underlying. The transaction costs of derivatives can be high relative to the value of the derivatives, but these costs are typically low relative to the value of the underlying. Thus, an investor who wants to take a position in, say, an equity market index would likely find it less costly to use the futures to get a given degree of exposure than to invest directly in the index to get that same exposure.

Derivative markets also typically have greater liquidity than the underlying spot markets, a result of the smaller amount of capital required to trade derivatives than to get the equivalent exposure directly in the underlying. Futures margin requirements and option premiums are quite low relative to the cost of the underlying.

One other extremely valuable operational advantage of derivative markets is the ease with which one can go short. With derivatives, it is nearly as easy to take a short position as to take a long position, whereas for the underlying asset, it is almost always much more difficult to go short than to go long. In fact, for many commodities, short selling is nearly impossible.

5.4. Market Efficiency

In the study of portfolio management, you learn that an efficient market is one in which no single investor can consistently earn returns in the long run in excess of those commensurate with the risk assumed. Of course, endless debates occur over whether equity markets are efficient. No need to resurrect that issue here, but let us proceed with the assumption that equity markets—and, in fact, most free and competitive financial markets—are reasonably efficient. This assumption does not mean that abnormal returns can never be earned, and indeed prices do get out of line with fundamental values. But competition, the relatively free flow of

[19] The Chicago Board Options Exchange publishes a measure of the implied volatility of the S&P 500 Index option, which is called the VIX (volatility index). The VIX is widely followed and is cited as a measure of investor uncertainty and sometimes fear.

information, and ease of trading tend to bring prices back in line with fundamental values. Derivatives can make this process work even more rapidly.

When prices deviate from fundamental values, derivative markets offer less costly ways to exploit the mispricing. As noted earlier, less capital is required, transaction costs are lower, and short selling is easier. We also noted that as a result of these features, it is possible, indeed likely, that fundamental value will be reflected in the derivatives markets before it is restored in the underlying market. Although this time difference could be only a matter of minutes, for a trader seeking abnormal returns, a few minutes can be a valuable opportunity.

All these advantages of derivatives markets make the financial markets in general function more effectively. Investors are far more willing to trade if they can more easily manage their risk, trade at lower cost and with less capital, and go short more easily. This increased willingness to trade increases the number of market participants, which makes the market more liquid. A very liquid market may not automatically be an efficient market, but it certainly has a better chance of being one.

Even if one does not accept the concept that financial markets are efficient, it is difficult to say that markets are not more effective and competitive with derivatives. Yet, many blame derivatives for problems in the market. Let us take a look at these arguments.

6. CRITICISMS AND MISUSES OF DERIVATIVES

The history of financial markets is filled with extreme ups and downs, which are often called bubbles and crashes. Bubbles occur when prices rise for a long time and appear to exceed fundamental values. Crashes occur when prices fall rapidly. Although bubbles, if they truly exist, are troublesome, crashes are even more so because nearly everyone loses substantial wealth in a crash. A crash is then typically followed by a government study commissioned to find the causes of the crash. In the last 30 years, almost all such studies have implicated derivatives as having some role in causing the crash. Of course, because derivatives are widely used and involve a high degree of leverage, it is a given that they would be seen in a crash. It is unclear whether derivatives are the real culprit or just the proverbial smoking gun used by someone to do something wrong.

The two principal arguments against derivatives are that they are such speculative devices that they effectively permit legalized gambling and that they destabilize the financial system. Let us look at these points more closely.

6.1. Speculation and Gambling

As noted earlier, derivatives are frequently used to manage risk. In many contexts, this use involves hedging or laying off risk. Naturally, for hedging to work, there must be speculators. Someone must accept the risk. Derivatives markets are unquestionably attractive to speculators. All the benefits of derivatives draw speculators in large numbers, and indeed they should. The more speculators that participate in the market, the cheaper it is for hedgers to lay off risk. These speculators take the form of hedge funds and other professional traders who willingly accept risk that others need to shed. In recent years, the rapid growth of these types of investors has been alarming to some but almost surely has been beneficial for all investors.

Unfortunately, the general image of speculators is not a good one. Speculators are often thought to be short-term traders who attempt to exploit temporary inefficiencies, caring little about long-term fundamental values. The profits from short-term trading are almost always taxed more heavily than the profits from long-term trading, clearly targeting and in some sense punishing speculators. Speculators are thought to engage in price manipulation and to trade at extreme prices.[20] All of this type of trading is viewed more or less as just a form of legalized gambling.

In most countries, gambling is a heavily regulated industry. In the United States, only certain states permit private industry to offer gambling. Many states operate gambling only through the public sector in the form of state-run lotteries. Many people view derivatives trading as merely a form of legalized and uncontrolled gambling.

Yet, there are notable differences between gambling and speculation. Gambling typically benefits only a limited number of participants and does not generally help society as a whole. But derivatives trading brings extensive benefits to financial markets, as explained earlier, and thus does benefit society as a whole. In short, the benefits of derivatives are broad, whereas the benefits of gambling are narrow.

Nonetheless, the argument that derivatives are a form of legalized gambling will continue to be made. Speculation and gambling are certainly both forms of financial risk taking, so these arguments are not completely off base. But insurance companies speculate on loss claims, mutual funds that invest in stocks speculate on the performance of companies, and entrepreneurs go up against tremendous odds to speculate on their own ability to create successful businesses. These so-called speculators are rarely criticized for engaging in a form of legalized gambling, and indeed entrepreneurs are praised as the backbone of the economy. Really, all investment is speculative. So, why is speculation viewed as such a bad thing by so many? The answer is unclear.

6.2. Destabilization and Systemic Risk

The arguments against speculation through derivatives often go a step further, claiming that it is not merely speculation or gambling per se but rather that it has destabilizing consequences. Opponents of derivatives claim that the very benefits of derivatives (low cost, low capital requirements, ease of going short) result in an excessive amount of speculative trading that brings instability to the market. They argue that speculators use large amounts of leverage, thereby subjecting themselves and their creditors to substantial risk if markets do not move in their hoped-for direction. Defaults by speculators can then lead to defaults by their creditors, their creditors' creditors, and so on. These effects can, therefore, be systemic and reflect an epidemic contagion whereby instability can spread throughout markets and an economy, if not the entire world. Given that governments often end up bailing out some banks and insurance companies, society has expressed concern that the risk managed with derivatives must be controlled.

This argument is not without merit. Such effects occurred in the Long-Term Capital Management fiasco of 1998 and again in the financial crisis of 2008, in which derivatives, particularly credit default swaps, were widely used by many of the problem entities. Responses to such events typically take the course of calling for more rules and regulations restricting the use of derivatives, requiring more collateral and credit mitigation measures, backing up banks with more capital, and encouraging, if not requiring, OTC derivatives to be centrally cleared like exchange-traded derivatives.

[20] Politicians and regulators have been especially critical of energy market speculators. Politicians, in particular, almost always blame rising oil prices on speculators, although credit is conspicuously absent for falling oil prices.

In response, however, we should note that financial crises—including the South Sea and Mississippi bubbles and the stock market crash of 1929, as well as a handful of economic calamities of the 19th and 20th centuries—have existed since the dawn of capitalism. Some of these events preceded the era of modern derivatives markets, and others were completely unrelated to the use of derivatives. Some organizations, such as Orange County, California, in 1994–1995, have proved that derivatives are not required to take on excessive leverage and nearly bring the entity to ruin. Proponents of derivatives argue that derivatives are but one of many mechanisms through which excessive risk can be taken. Derivatives may seem dangerous, and they can be if misused, but there are many ways to take on leverage that look far less harmful but can be just as risky.

Another criticism of derivatives is simply their complexity. Many derivatives are extremely complex and require a high-level understanding of mathematics. The financial industry employs many mathematicians, physicists, and computer scientists. This single fact has made many distrust derivatives and the people who work on them. It is unclear why this reason has tarnished the reputation of the derivatives industry. Scientists work on complex problems in medicine and engineering without public distrust. One explanation probably lies in the fact that scientists create models of markets by using scientific principles that often fail. To a physicist modeling the movements of celestial bodies, the science is reliable and the physicist is unlikely to misapply the science. The same science applied to financial markets is far less reliable. Financial markets are driven by the actions of people who are not as consistent as the movements of celestial bodies. When financial models fail to work as they should, the scientists are often blamed for either building models that are too complex and unable to accurately capture financial reality or misusing those models, such as using poor estimates of inputs. And derivatives, being so widely used and heavily leveraged, are frequently in the center of it all.

EXAMPLE 6 Purposes and Controversies of Derivative Markets

1. Which of the following is **not** an advantage of derivative markets?
   A. They are less volatile than spot markets.
   B. They facilitate the allocation of risk in the market.
   C. They incur lower transaction costs than spot markets.
2. Which of the following pieces of information is **not** conveyed by at least one type of derivative?
   A. The volatility of the underlying.
   B. The most widely used strategy of the underlying.
   C. The price at which uncertainty in the underlying can be eliminated.
3. Which of the following responds to the criticism that derivatives can be destabilizing to the underlying market?
   A. Market crashes and panics have occurred since long before derivatives existed.
   B. Derivatives are sufficiently regulated that they cannot destabilize the spot market.
   C. The transaction costs of derivatives are high enough to keep their use at a minimum level.

Solution to 1: A is correct. Derivative markets are not by nature more or less volatile than spot markets. They facilitate risk allocation by making it easier and less costly to transfer risk, and their transaction costs are lower than those of spot markets.

Solution to 2: B is correct. Options do convey the volatility of the underlying, and futures, forwards, and swaps convey the price at which uncertainty in the underlying can be eliminated. Derivatives do not convey any information about the use of the underlying in strategies.

Solution to 3: A is correct. Derivatives regulation is not more and is arguably less than spot market regulation, and the transaction costs of derivatives are not a deterrent to their use; in fact, derivatives are widely used. Market crashes and panics have a very long history, much longer than that of derivatives.

An important element of understanding and using derivatives is having a healthy respect for their power. Every day, we use chemicals, electricity, and fire without thinking about their dangers. We consume water and drive automobiles, both of which are statistically quite dangerous. Perhaps these risks are underappreciated, but it is more likely the case that most adults learn how to safely use chemicals, electricity, fire, water, and automobiles. Of course, there are exceptions, many of which are foolish, and foolishness is no stranger to the derivatives industry. The lesson here is that derivatives can make our financial lives better, but like chemicals, electricity, and all the rest, we need to know how to use them safely, which is why they are an important part of the CFA curriculum.

Later in the curriculum, you will learn a great deal about how derivatives are priced. At this point, we introduce the pricing of derivatives. This material not only paves the way for a deeper understanding of derivatives but also complements earlier material by helping you understand how derivatives work.

7. ELEMENTARY PRINCIPLES OF DERIVATIVE PRICING

Pricing and valuation are fundamental elements of the CFA Program. The study of fixed-income and equity securities, as well as their application in portfolio management, is solidly grounded on the principle of valuation. In valuation, the question is simple: What is something worth? Without an answer to that question, one can hardly proceed to use that *something* wisely.

Determining what a derivative is worth is similar to determining what an asset is worth. As you learn in the fixed-income and equity readings, value is the present value of future cash flows, with discounting done at a rate that reflects both the opportunity cost of money and the risk. Derivatives valuation applies that same principle but in a somewhat different way.

Think of a derivative as *attached* to an underlying. We know that the derivative *derives* its value from the value of the underlying. If the underlying's value changes, so should the value of the derivative. The underlying takes its value from the discounted present value of the expected future cash flows it offers, with discounting done at a rate reflecting the investor's risk tolerance. But if the value of the underlying is embedded in the value of the derivative, it would be double counting to discount the derivative's expected future cash flows at a risky discount rate. That effect has already been incorporated into the value of the underlying, which goes into the value of the derivative.

Derivatives usually take their values from the underlying by constructing a hypothetical combination of the derivatives and the underlyings that eliminates risk. This combination is typically called a **hedge portfolio**. With the risk eliminated, it follows that the hedge portfolio should earn the risk-free rate. A derivative's value is the price of the derivative that forces the hedge portfolio to earn the risk-free rate.

This principle of derivative valuation relies completely on the ability of an investor to hold or store the underlying asset. Let us take a look at what that means.

7.1. Storage

As noted previously, the first derivatives were agricultural commodities. Most of these commodities can be stored (i.e., held) for a period of time. Some extreme cases, such as oil and gold, which are storable for millions of years, are excellent examples of fully storable commodities. Grains, such as wheat and corn, can be stored for long but not infinite periods of time. Some commodities, such as bananas, are storable for relatively short periods of time. In the CFA Program, we are more interested in financial assets. Equities and currencies have perpetual storability, whereas bonds are storable until they mature.

Storage incurs costs. Commodity storage costs can be quite expensive. Imagine storing 1,000 kilograms of gold or a million barrels of oil. Financial assets, however, have relatively low storage costs. Some assets pay returns during storage. Stocks pay dividends and bonds pay interest. The net of payments offered minus storage costs plays a role in the valuation of derivatives.

An example earlier in this reading illustrates this point. Suppose an investor holds a dividend-paying stock and wants to eliminate the uncertainty of its selling price over a future period of time. Suppose further that the investor enters into a forward contract that commits him to deliver the stock at a later date, for which he will receive a fixed price. With uncertainty eliminated, the investor should earn the risk-free rate, but in fact, he does not. He earns more because while holding the stock, he collects dividends. Therefore, he should earn the risk-free rate *minus* the dividend yield, a concept known as the cost of carry, which will be covered in great detail in later readings. The cost of carry *plus* the dividends he earns effectively means that he makes the risk-free rate. Now, no one is claiming that this is a good way to earn the risk-free rate. There are many better ways to do that, but this strategy could be executed. There is one and only one forward price that guarantees that this strategy earns a return of the risk-free rate minus the dividend yield, or the risk-free rate after accounting for the dividends collected. If the forward price at which contracts are created does not equal this price, investors can take advantage of this discrepancy by engaging in arbitrage, which is discussed in the next section.

Forwards, futures, swaps, and options are all priced in this manner. Hence, they rely critically on the ability to store or hold the asset. Some underlyings are not storable. We previously mentioned electricity. It is produced and consumed almost instantaneously. Weather is also not storable. Fresh fish have very limited storability. Although this absence of storability may not be the reason, derivative markets in these types of underlyings have not been particularly successful, whereas those in underlyings that are more easily storable have often been successful.

The opposite of storability is the ability to go short—that is, to borrow the underlying, sell it, and buy it back later. We discussed earlier that short selling of some assets can be difficult. It is not easy to borrow oil or soybeans. There are ways around this constraint, but derivatives valuation is generally much easier when the underlying can be shorted. This point is discussed in more depth later in the curriculum.

7.2. Arbitrage

What we have been describing is the foundation of the principle of **arbitrage**. In well-functioning markets with low transaction costs and a free flow of information, the same asset cannot sell for more than one price. If it did, someone would buy it in the cheaper market and sell it in the more expensive market, earning a riskless profit. The combined actions of all parties doing this would push up the lower price and push down the higher price until they converged. For this reason, arbitrage is often referred to as the **law of one price**. Of course, for arbitrage to be feasible, the ability to purchase and sell short the asset is important.

Obviously, this rule does not apply to all markets. The same consumer good can easily sell for different prices, which is one reason why people spend so much time shopping on the internet. The costs associated with purchasing the good in the cheaper market and selling it in the more expensive market can make the arbitrage not worthwhile. The absence of information on the very fact that different prices exist would also prevent the arbitrage from occurring. Although the internet and various price-comparing websites reduce these frictions and encourage all sellers to offer competitive prices, consumer goods are never likely to be arbitragable.[21]

Financial markets, of course, are a different matter. Information on securities prices around the world is quite accessible and relatively inexpensive. Most financial markets are fairly competitive because dealers, speculators, and brokers attempt to execute trades at the best prices. Arbitrage is considered a dependable rule in the financial markets. Nonetheless, there are people who purport to make a living as arbitrageurs. How could they exist? To figure that out, first consider some examples of arbitrage.

The simplest case of an arbitrage might be for the same stock to sell at different prices in two markets. If the stock were selling at \$52 in one market and \$50 in another, an arbitrageur would buy the stock at \$50 in the one market and sell it at \$52 in the other. This trade would net an immediate \$2 profit at no risk and would not require the commitment of any of the investor's capital. This outcome would be a strong motivation for all arbitrageurs, and their combined actions would force the lower price up and the higher price down until the prices converged.

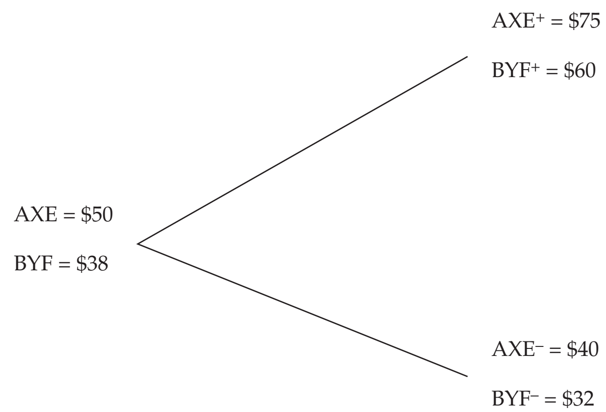
But what would be the final price? It is entirely possible that \$50 is the true fundamental value and \$52 is too high. Or \$52 could be the true fundamental value and \$50 is too low. Or the true fundamental value could lie somewhere between the two. Arbitrage does not tell us the true fundamental value. It is not an *absolute* valuation methodology, such as the discounted cash flow equity valuation model. It is a *relative* valuation methodology. It tells us the correct price of one asset or derivative *relative to* another asset or derivative.

Now, consider another situation, illustrated in Exhibit 6. Observe that we have one stock, AXE Electronics, that today is worth \$50 and one period later will be worth either \$75 or \$40. We will denote these prices as AXE = \$50, AXE^+ = \$75, and AXE^- = \$40. Another stock, BYF Technology, is today worth \$38 and one period later will be worth \$60 or \$32. Thus, BYF = \$38,

[21] If the same consumer good sells for different prices in markets with a relatively free flow of information (e.g., via price-comparing websites), it still may not be possible to truly arbitrage. Buying the good at a lower price and selling it at a higher price but less than the price of the most expensive seller may not be practical, but the most expensive seller may be driven out of business. When everyone knows what everyone else is charging, the same effect of arbitrage can still occur.

$BYF^+ = \$60$, and $BYF^- = \$32$. Assume that the risk-free borrowing and lending rate is 4%. Also assume no dividends are paid on either stock during the period covered by this example.

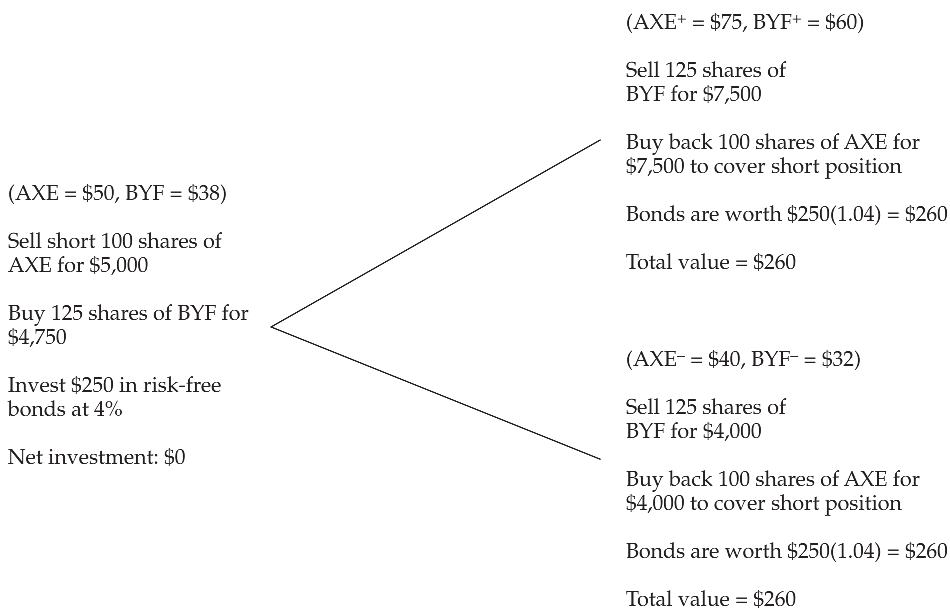
EXHIBIT 6 Arbitrage Opportunity with Stock AXE, Stock BYF, and a Risk-Free Bond



Note: The risk-free rate is 4%.

The opportunity exists to make a profit at no risk without committing any of our funds, as demonstrated in Exhibit 7. Suppose we borrow 100 shares of stock AXE, which is selling for \$50, and sell them short, thereby receiving \$5,000. We take \$4,750 and purchase 125 shares of stock BYF ($125 \times \$38 = \$4,750$). We invest the remaining \$250 in risk-free bonds at 4%. This transaction will not require us to use 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.

EXHIBIT 7 Execution of Arbitrage Transaction with Stock AXE, Stock BYF, and a Risk-Free Bond



If the top outcome in Exhibit 7 occurs, we sell the 125 shares of BYF for 125 × \$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 × 1.04 = \$260. If the bottom outcome occurs, we sell the 125 shares of BYF for 125 × \$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 invested no money of our own and end up with a sure \$260. It should be apparent that this transaction is extremely attractive, 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 is reached, at which point this transaction would no longer be profitable. As noted earlier, we cannot be sure of the correct fundamental price, but let us assume that BYF's price remains constant. Then AXE would fall to \$47.50. Alternatively, if we assume that AXE's price remains constant, then the price of BYF would rise to \$40. These values are obtained by noting that the prices for both outcomes occur according to the ratio 1.25 (\$75/\$60 = 1.25; \$40/\$32 = 1.25). Thus, their initial prices should be consistent with that ratio. If BYF is \$38, AXE should be \$38 × 1.25 = \$47.50. If AXE is \$50, BYF should be \$40.00 because \$40.00 × 1.25 = \$50. Of course, the two prices could settle in between. Arbitrage is only a relative pricing method. It prices the two stocks in relation to each other but does not price either on the basis of its own fundamentals.

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 later in the curriculum, when derivatives are involved, the simplification here is relatively safe. As we know, the price of a derivative is determined by the price of the underlying. Hence, when the underlying is at one particular price, the derivative's price will be determined by that price. The two assets need not be two stocks; one can be a stock and the other can be a derivative on the stock.

To see that point, consider another type of arbitrage opportunity that involves a forward contract. Recall from the previous example that at the start, AXE sells for \$50. Suppose we borrow \$50 at 4% 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 the next period. The forward contract requires that we deliver the stock and accept \$54 for it. And of course, we will owe \$50 × 1.04 = \$52 on the loan.

Now consider the two outcomes. Regardless of the outcome, the end result is the same. The forward contract fixes the delivery price of the stock at \$54:

AXE goes to \$75	
Deliver stock to settle forward contract	+ \$54
Pay back loan	– \$52
Net	+ \$2
AXE goes to \$40	
Deliver stock to settle forward contract	+ \$54
Pay back loan	– \$52
Net	+ \$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 and we will always make \$2.[22] The key point is that we faced no risk and did not have to invest any of our own money, but ended up with \$2, which is clearly a good trade. The \$2 is an arbitrage profit. But where did it originate?

It turns out that the forward price, \$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, which is 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 cover this point later in the curriculum, but for now consider that you have just seen your first derivative pricing model.[23]

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

To summarize, the forces of arbitrage in financial markets assure us that the same asset cannot sell for different prices, nor can two equivalent combinations of assets that produce the same results sell for different prices. Realistically, some arbitrage opportunities can exist on a temporary basis, but they will be quickly exploited, bringing relative prices back in line with each other. Other apparent arbitrage opportunities will be too small to warrant exploiting.

Not to be naive, however, we must acknowledge that there is a large industry of people who call themselves 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 the simple examples used here. Many involve estimating information, which can result in differing opinions. Arbitrage involving options, for example, usually requires an estimate of a stock's volatility. Different participants have different opinions about the volatility. It is quite possible that the two counterparties trading with each other believe that each is arbitraging against the other.[24]

But more importantly, the absence of arbitrage opportunities is upheld, ironically, only if participants believe that arbitrage opportunities do exist. If traders believe that no opportunities exist to earn arbitrage profits, then traders will not follow market prices and compare those prices with what they ought to be. Thus, eliminating arbitrage opportunities requires that participants be alert in watching for arbitrage opportunities. In other words, strange as it may sound, disbelief and skepticism concerning the absence of arbitrage opportunities are required for the no-arbitrage rule to be upheld.

Markets in which arbitrage opportunities are either nonexistent or quickly eliminated are relatively efficient markets. Recall that efficient markets are those in which it is not possible to consistently 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

[22] A good study suggestion is to try this example with any future stock price. You should get the same result, a \$2 risk-free profit.

[23] This illustration is the quick look at forward pricing alluded to in Section 3.1.1.

[24] In reality, many of the transactions that arbitrageurs do are not really arbitrage. They are quite speculative. For example, many people call themselves arbitrageurs because they buy companies that are potential takeover targets and sell the companies they think will be the buyers. This transaction is not arbitrage by any stretch of the definition. Some transactions are called "risk arbitrage," but this term is an oxymoron. As an investment professional, you should simply be prepared for such misuses of words, which simply reflect the flexibility of language.

definitely examples of abnormal returns. Thus, they are the most egregious violations of the principle of market efficiency.

Throughout the derivatives component of the CFA curriculum, we will use the principle of arbitrage as a dominant theme and assume that arbitrage opportunities cannot exist for any significant length of time nor can any one investor consistently capture them. Thus, prices must conform to models that assume no arbitrage. But 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. Consider the rule of arbitrage a law that will be broken from time to time but one that holds far more often than not and one that should be understood and respected.

EXAMPLE 7 Arbitrage

1. Which of the following is a result of arbitrage?
   A. The law of one price
   B. The law of similar prices
   C. The law of limited profitability
2. When an arbitrage opportunity exists, what happens in the market?
   A. The combined actions of all arbitrageurs force the prices to converge.
   B. The combined actions of arbitrageurs result in a locked-limit situation.
   C. The combined actions of all arbitrageurs result in sustained profits to all.
3. Which of the following accurately defines arbitrage?
   A. An opportunity to make a profit at no risk
   B. An opportunity to make a profit at no risk and with the investment of no capital
   C. An opportunity to earn a return in excess of the return appropriate for the risk assumed
4. Which of the following ways best describes how arbitrage contributes to market efficiency?
   A. Arbitrage penalizes those who trade too rapidly.
   B. Arbitrage equalizes the risks taken by all market participants.
   C. Arbitrage improves the rate at which prices converge to their relative fair values.

Solution to 1: A is correct. Arbitrage forces equivalent assets to have a single price. There is nothing called the law of similar prices or the law of limited profitability.

Solution to 2: A is correct. Prices converge because of the heavy demand for the cheaper asset and the heavy supply of the more expensive asset. Profits are not sustained, and, in fact, they are eradicated as prices converge. Locked-limit is a condition in the futures market and has nothing to do with arbitrage.

Solution to 3: B is correct. An opportunity to profit at no risk could merely describe the purchase of a risk-free asset. An opportunity to earn a return in excess of the return appropriate for the risk assumed is a concept studied in portfolio management and is often referred to as an abnormal return. It is certainly desirable but is hardly an arbitrage because it requires the assumption of risk and the investment of capital. Arbitrage is risk free and requires no capital because selling the overpriced asset produces the funds to buy the underpriced asset.

Solution to 4: C is correct. Arbitrage imposes no penalties on rapid trading; in fact, it tends to reward those who trade rapidly to take advantage of arbitrage opportunities. Arbitrage has no effect of equalizing risk among market participants. Arbitrage does result in an acceleration of price convergence to fair values relative to instruments with equivalent payoffs.

8. SUMMARY

This first reading on derivatives introduces you to the basic characteristics of derivatives, including the following points:

- A derivative is a financial instrument that derives its performance from the performance of an underlying asset.
- The underlying asset, called the underlying, trades in the cash or spot markets and its price is called the cash or spot price.
- Derivatives consist of two general classes: forward commitments and contingent claims.
- Derivatives can be created as standardized instruments on derivatives exchanges or as customized instruments in the over-the-counter market.
- Exchange-traded derivatives are standardized, highly regulated, and transparent transactions that are guaranteed against default through the clearinghouse of the derivatives exchange.
- Over-the-counter derivatives are customized, flexible, and more private and less regulated than exchange-traded derivatives, but are subject to a greater risk of default.
- A forward contract is an over-the-counter derivative contract in which two parties agree that one party, the buyer, will purchase an underlying asset from the other party, the seller, at a later date and at a fixed price they agree upon when the contract is signed.
- A futures contract is similar to a forward contract but is a standardized derivative contract created and traded on a futures exchange. In the contract, two parties agree that one party, the buyer, will purchase an underlying asset from the other party, the seller, at a later date and at a price agreed on by the two parties when the contract is initiated. In addition, there is a daily settling of gains and losses and a credit guarantee by the futures exchange through its clearinghouse.
- A swap is an over-the-counter derivative contract in which two parties agree to exchange a series of cash flows whereby one party pays a variable series that will be determined by an underlying asset or rate and the other party pays either a variable series determined by a different underlying asset or rate or a fixed series.
- An option is a derivative contract in which one party, the buyer, pays a sum of money to the other party, the seller or writer, and receives the right to either buy or sell an underlying asset at a fixed price either on a specific expiration date or at any time prior to the expiration date.
- A call is an option that provides the right to buy the underlying.
- A put is an option that provides the right to sell the underlying.
- Credit derivatives are a class of derivative contracts between two parties, the credit protection buyer and the credit protection seller, in which the latter provides protection to the former against a specific credit loss.

- A credit default swap is the most widely used credit derivative. It is a derivative contract between two parties, a credit protection buyer and a credit protection seller, in which the buyer makes a series of payments to the seller and receives a promise of compensation for credit losses resulting from the default of a third party.
- An asset-backed security is a derivative contract in which a portfolio of debt instruments is assembled and claims are issued on the portfolio in the form of tranches, which have different priorities of claims on the payments made by the debt securities such that prepayments or credit losses are allocated to the most-junior tranches first and the most-senior tranches last.
- Derivatives can be combined with other derivatives or underlying assets to form hybrids.
- Derivatives are issued on equities, fixed-income securities, interest rates, currencies, commodities, credit, and a variety of such diverse underlyings as weather, electricity, and disaster claims.
- Derivatives facilitate the transfer of risk, enable the creation of strategies and payoffs not otherwise possible with spot assets, provide information about the spot market, offer lower transaction costs, reduce the amount of capital required, are easier than the underlyings to go short, and improve the efficiency of spot markets.
- Derivatives are sometimes criticized for being a form of legalized gambling and for leading to destabilizing speculation, although these points can generally be refuted.
- Derivatives are typically priced by forming a hedge involving the underlying asset and a derivative such that the combination must pay the risk-free rate and do so for only one derivative price.
- Derivatives pricing relies heavily on the principle of storage, meaning the ability to hold or store the underlying asset. Storage can incur costs but can also generate cash, such as dividends and interest.
- Arbitrage is the condition that two equivalent assets or derivatives or combinations of assets and derivatives sell for different prices, leading to an opportunity to buy at the low price and sell at the high price, thereby earning a risk-free profit without committing any capital.
- The combined actions of arbitrageurs bring about a convergence of prices. Hence, arbitrage leads to the law of one price: Transactions that produce equivalent results must sell for equivalent prices.

PROBLEMS

1. A derivative is *best* described as a financial instrument that derives its performance by:
   A. passing through the returns of the underlying.
   B. replicating the performance of the underlying.
   C. transforming the performance of the underlying.
2. Compared with exchange-traded derivatives, over-the-counter derivatives would *most likely* be described as:
   A. standardized.
   B. less transparent.
   C. more transparent.

3. Exchange-traded derivatives are:
   A. largely unregulated.
   B. traded through an informal network.
   C. guaranteed by a clearinghouse against default.
4. Which of the following derivatives is classified as a contingent claim?
   A. Futures contracts
   B. Interest rate swaps
   C. Credit default swaps
5. In contrast to contingent claims, forward commitments provide the:
   A. right to buy or sell the underlying asset in the future.
   B. obligation to buy or sell the underlying asset in the future.
   C. promise to provide credit protection in the event of default.
6. Which of the following derivatives provide payoffs that are non-linearly related to the payoffs of the underlying?
   A. Options
   B. Forwards
   C. Interest rate swaps
7. An interest rate swap is a derivative contract in which:
   A. two parties agree to exchange a series of cash flows.
   B. the credit seller provides protection to the credit buyer.
   C. the buyer has the right to purchase the underlying from the seller.
8. Forward commitments subject to default are:
   A. forwards and futures.
   B. futures and interest rate swaps.
   C. interest rate swaps and forwards.
9. Which of the following derivatives is *least likely* to have a value of zero at initiation of the contract?
   A. Futures
   B. Options
   C. Forwards
10. A credit derivative is a derivative contract in which the:
    A. clearinghouse provides a credit guarantee to both the buyer and the seller.
    B. seller provides protection to the buyer against the credit risk of a third party.
    C. the buyer and seller provide a performance bond at initiation of the contract.
11. Compared with the underlying spot market, derivative markets are *more likely* to have:
    A. greater liquidity.
    B. higher transaction costs.
    C. higher capital requirements.
12. Which of the following characteristics is *least likely* to be a benefit associated with using derivatives?
    A. More effective management of risk
    B. Payoffs similar to those associated with the underlying
    C. Greater opportunities to go short compared with the spot market
13. Which of the following is *most likely* to be a destabilizing consequence of speculation using derivatives?
    A. Increased defaults by speculators and creditors
    B. Market price swings resulting from arbitrage activities
    C. The creation of trading strategies that result in asymmetric performance

14. The law of one price is *best* described as:
    A. the true fundamental value of an asset.
    B. earning a risk-free profit without committing any capital.
    C. two assets that will produce the same cash flows in the future must sell for equivalent prices.
15. Arbitrage opportunities exist when:
    A. two identical assets or derivatives sell for different prices.
    B. combinations of the underlying asset and a derivative earn the risk-free rate.
    C. arbitrageurs simultaneously buy takeover targets and sell takeover acquirers.