

An Introduction to Derivative Instruments

After you read this chapter, you should be able to answer the following questions:

- What are the basic features of forward contracts, futures contracts, and options contracts?
- Why do derivative securities exist? How do they help meet investor needs and increase market efficiency?
- What are the similarities and differences between forward contracts and futures contracts?
- What terminology do we use to describe option contracts?
- What does a payoff diagram show?
- What are the risks and potential returns from options positions such as buying and writing calls; buying and writing puts; owning long and short positions in spreads, straddles, strangles, or butterfly spreads?
- What are the relationships among the prices of puts, calls, and futures?
- What are some uses of derivatives in investment analysis and portfolio management?

Our financial system has always demonstrated a remarkable tendency to evolve and develop new markets and instruments. In the past quarter century, this tendency has been exhibited most clearly in the rapid development and use of derivative instruments. A derivative instrument has its value determined by, or derived from, the value of another investment vehicle, called the underlying asset or security. Earlier in the book we briefly described options and futures, which form the basis for much derivative trading. However, many new instruments have been created that possess some of the characteristics of options or futures and indeed some instruments that are like both options and futures. The incredible growth in the use of derivatives and the occasional controversy they engender make it all the more important that we develop an early understanding of derivatives and their role in our financial markets. Thus, in this chapter we introduce the basic derivative instruments—forwards, futures, and options—and describe their characteristics, pricing, and some selected investment and portfolio management strategies.

Forward contracts are agreements between two parties, the buyer and seller, for the former to purchase an asset from the latter at a specific future date at a price agreed on up front. No money changes hands between the buyer and seller when the forward contract is initiated, thus, a forward contract itself is not an asset but merely an agreement. Forward contracts are created in the over-the-counter market. Futures contracts are somewhat like forward contracts in that they represent an agreement between a buyer and a seller to exchange a specified amount of cash for an asset at a specified future date. Unlike forward contracts, futures contracts trade on an exchange and are subject to a daily settling-up process, which will be described in more detail later.

Options are instruments that grant to their owners the right, but not the obligation, to buy or sell something at a fixed price, either on a specific date or any time up to a specific date. Unlike a forward or futures contract, the owner of an options contract is not obliged to follow through on it if the transaction is not in his or her best interest; thus



the name "option" contract. The owner has the option to execute, or not execute, the contract.¹

In derivatives parlance, the buyer and seller of a contract are sometimes referred to as counterparties in the derivatives transaction. The buyer of a contract is said to be *long* in the contract. The seller, or writer of the contract, is *short* the contract.

Although their names are different, forwards, futures, and options have similar general characteristics. First, they all specify the asset underlying the contract and the quantity of the asset to be traded. Second, they all specify a length of time over which the contract is in force. The transaction is to be completed, or the option exercised, on or before the contract's expiration date. Third, they allow the buyer of the contract to lock in a transaction price; we call this the exercise or strike price. If the purchaser exercises his or her option, or when the forward or futures contract is fulfilled, the trade occurs at the exercise price specified in the contract. Fourth, the profit or loss on the contract depends on the relationship between the asset's *market price* (or *spot price*) and the exercise price at the time the contract is executed or when it expires. Generally, profits or losses on forward and futures contracts closely follow changes in the asset's market price. Notably, owners of option contracts can protect themselves against large losses by merely choosing not to exercise their option.

WHY DO DERIVATIVES EXIST?

Most assets that we have discussed—such as stocks, bonds, gold, or real estate—are traded in the cash or spot market. The primary and secondary markets we examined earlier in the text are examples of spot markets. In these markets trades occur, and cash, along with ownership of the asset, is transferred between buyer and seller.

At times, it may be advantageous to enter into a transaction immediately with the promise that the exchange of the asset and money will take place at a future time. As an illustration, a portfolio manager may anticipate month-end cash flows from investors but wishes to purchase attractively priced securities now, fearing their prices will rise. A corporate treasurer may want to lock in today's borrowing rates, fearing they will rise in the future. A farmer may want to lock in attractive July corn prices, although his crops will not be harvested for several months.

Such exchanges allow a transaction price to be determined today for a trade that will not occur until a mutually agreed on future date. This can occur with a forward contract or a futures contract. As an example, in June a wheat farmer can lock in the price at which he can sell his harvest in September by selling a September wheat contract, which means that the profits on his crop will not be affected by price swings in the wheat spot market between now and harvest time.

¹Another type of derivative, called a *swap*, is an agreement between two investors to exchange a series of cash flows over time. For example, a borrower paying a fixed rate of interest who believes interest rates will fall can enter a swap agreement in which he will pay a floating interest rate to a counterparty while the counterparty will pay a fixed interest rate to him. The actual amount of cash that changes hands is based on the *notional principal*. The interest cash flows equal the party's interest rate times the notional amount. The notional principal is never paid to anyone; its purpose is to be a scaling factor to determine the size of the interest payments in the swap agreement. A party paying a fixed rate of 0.5 percent a month with a notional amount of \$100 million will make monthly payments of \$500,000; with a notional principal of \$1 billion the monthly payments will be \$5 million. Equity swaps exist, too. An example of an equity swap will have a portfolio manager paying the S&P 500 monthly return to a counterparty who in turn will pay a fixed percentage return to the portfolio manager. In a bearish market environment such a swap can protect a portfolio against a decline in value but at the cost of giving up some of the portfolio's upside potential.

Others may wish to enter into an agreement that allows for a future cash transaction, but only if the contract buyer finds it in his best interest to do so. The option contract allows the purchaser to ultimately decide whether or not to execute the trade in the future. For example, a real estate developer may purchase an option to buy property at a fixed price during a specified time period; should property values rise, she will choose to exercise the option and purchase the land for the specified price. Alternatively, a wheat farmer may enter into an option contract to sell his harvest at a predetermined price; should the spot-market price for wheat be lower at harvest, he will execute his option and receive the predetermined price. In contrast, should the spot wheat price be higher, he will choose to sell his wheat at the higher spot price and let the option contract expire. Similar option contracts exist for financial assets such as individual stocks, stock indexes, interest rates, and currencies.

Over time, derivatives such as forwards, futures, and options have evolved to fulfill desirable economic purposes. They help shift risk from those who do not want to carry it to those who are willing to bear it. They also assist in forming cash prices and provide additional information to the market. Finally, the trading mechanisms for derivatives have evolved so that in many cases it may be less costly, in terms of both commissions and required investment, to invest in derivatives than in the cash market. In the following subsections we will discuss each of these benefits in more detail.

Risk Shifting

The farmer who wants to reduce his risk can hedge by locking in now a price for wheat to be delivered at harvest. He does this by entering into a forward or futures contract with someone who is willing to bear the risk of fluctuating spot prices. The buyer of the contract may be a speculator or grain processor who believes that wheat will sell at a higher spot price in the future and so agrees to buy the wheat in the future at the preset price.

The use of option contracts affects the asset's risk-return profile because the option owner can decide not to exercise it if the transaction becomes disadvantageous from her perspective. Thus, options can be used to control risk by limiting losses while protecting profit opportunities.

As these illustrations show, derivative contracts can help control risk and help to manage the expected return-risk tradeoff faced by an investor. Those wishing to reduce their exposure to a fluctuating spot price can do so by using derivatives. Similarly, an investor or speculator who is willing to increase (or "leverage") his exposure to risk can do so via appropriate derivatives trades. Later in this chapter we will give examples of several strategies that can be used to increase or decrease exposure to risk. Additionally, in Chapters 17 and 19 we will illustrate how to use derivatives to modify a portfolio's risk-return profile.

Price Formation

Speculators also trade in the derivative markets because they believe the asset is incorrectly priced based on their analysis and information. Because speculators bring additional information into the market, the prices of the underlying assets and their corresponding futures and option contracts should more accurately reflect the intrinsic values of the assets. As we show in Chapter 12, the spot, futures, and option prices are interrelated by arbitrage relationships. That means information affecting the spot market will also affect derivative prices and vice versa.

Derivative prices also provide information that can be analyzed to assist decision making. For example, some investors use futures prices as the market's best estimate for future spot prices. This can aid planning, as futures markets can provide these estimates

for certain commodities, financial assets, and currency exchange rates. The price formation function enhances market efficiency as participants in both the spot and derivatives markets trade based on their information and analysis. This will help market prices to reflect the intrinsic value of the spot-market asset.

Investment Cost Reduction

As the derivative markets have evolved, commissions are generally lower than in the corresponding cash market. Liquidity in this market is also enhanced as many hedgers and speculators trade derivatives. Rather than place a bet on the direction of the stock market by paying commissions and purchasing shares in each of the S&P 500 firms, they can purchase a single futures contract that represents the entire index. Therefore, portfolio managers can quickly adjust their portfolio's risk exposures at lower cost by using futures instead of spot-market trades. Unlike a spot-market transaction, commodity derivative contracts do not require the purchaser to pay for storing the commodity. Additionally, margin requirements are less in futures transactions than they are on the spot market.

Although they may seem esoteric and daunting at first, derivatives play an important economic role in allocating risk, forming prices, and facilitating transactions. Similar to other investment vehicles, careless or improper use of derivatives can lead to large losses. When taking a large position in one market, even risk-loving speculators will often hedge their risk to limit their loss by taking an offsetting position in another market.

FORWARD CONTRACTS

A forward contract is an agreement between two parties to exchange an asset at a specified price at a specified date. Because it is a contract, the buyer is obligated to purchase the asset and the seller is obligated to sell at the predetermined price (the exercise price) on the specified date (the expiration date). The buyer of the contract is said to be *long forward*; the seller is said to be *short forward*.

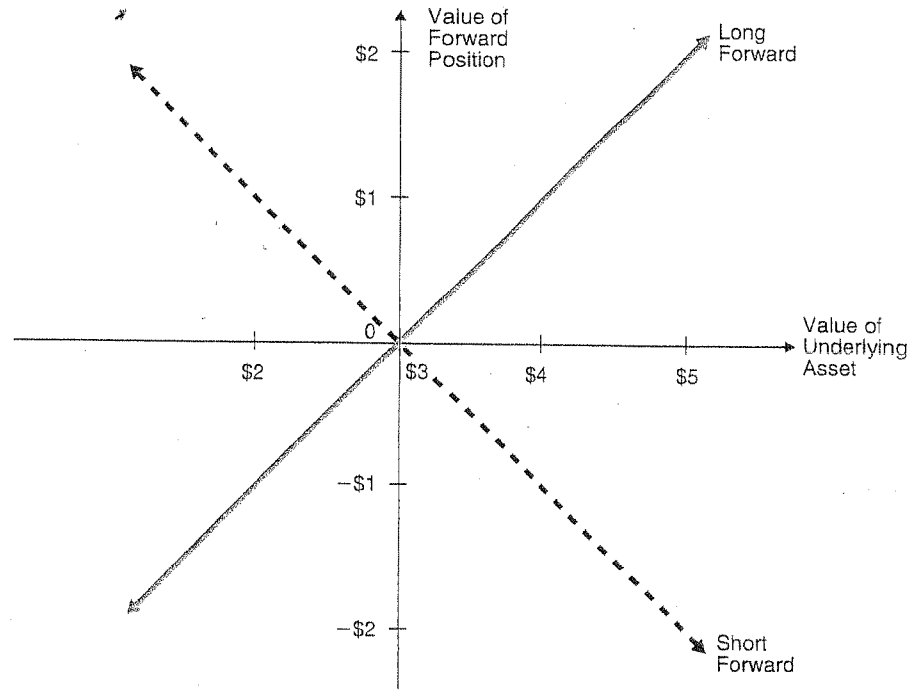
Forward contracts are traded over the counter and are generally not standardized, meaning that as long as the buyer and seller negotiate agreeable terms, they can create their own forward contract on virtually any commodity. Notably, this flexibility has a major drawback: *forward contracts are not liquid*. Should a buyer or seller wish to get out of a forward agreement, she needs to find another party to purchase it. Another potential problem with forwards is credit risk or default risk. The contract may not be executed as planned if the buyer cannot raise the cash needed to purchase the asset, or if the seller commits fraud by not delivering the asset to be sold.

The profit or loss on a forward contract relates directly to the relationship between the actual market price of the underlying asset and the exercise price contained in the contract. The value of a forward contract is realized only at the expiration date; no payments are made at the initiation of the contract and no cash transfers are made prior to expiration.

As shown in Exhibit 11.1, if the market price rises above the exercise price, the buyer gains (and the seller loses, because the asset will be sold at a price below current value); should the price fall below the exercise price, the buyer loses (and the seller gains, because the asset is sold for a price greater than its current value). Suppose a grain processor buys a forward contract from a farmer for October delivery of grain at a price of \$3 a bushel. Exhibit 11.1 shows the grain processor's payoff profile for her long forward position (heavy arrow). Should the October spot-market price be \$3 a bushel, the processor breaks even as the spot price equals the previously set forward price. If the

EXHIBIT 11.1 Payoff Profiles for Long and Short Positions in a Forward Contract

A farmer and a grain processor enter into a forward contract that obliges the farmer to sell grain to the processor at an exercise price of \$3 per bushel.



October spot price is \$4 a bushel, the processor gains \$1 a bushel by purchasing grain that has a \$4 market value at the \$3 forward price. The processor's profits rise dollar for dollar as the spot price rises above the \$3 forward price. Conversely, the processor's losses increase dollar for dollar as the spot price falls below the \$3 forward price. For instance, if the October spot price is only \$2, the processor loses \$1 per bushel; she is obligated to buy grain that has a \$2 market value for the \$3 forward price.

The situation is reversed for the farmer, who is short forward (dotted arrow). As the October spot-market price rises above \$3 a bushel, the farmer suffers an *opportunity loss* since he is obligated to sell his grain for \$3 a bushel. If the market price is \$4, he has a \$1-per-bushel opportunity loss; if the market price rises to \$5, he has a \$2-per-bushel opportunity loss; and so on. Conversely, for October spot prices under \$3, the farmer gains a dollar-for-dollar *opportunity profit*.

The diagram in Exhibit 11.1 is called a *payoff profile*; it illustrates the profits and losses on an investment. The payoff profile for a long forward position is similar to that from owning the underlying asset outright; price increases make the owner wealthier. Similarly, the payoff profile for a short forward position resembles that from a short sale of the underlying asset.

The large market for forward contracts in currencies allows corporations and financial institutions to enter into forward contracts to hedge exchange rate risks. The spot market for currencies is an informal network of financial institutions that trade large volumes of currencies by telephone or wire. Exhibit 11.2 illustrates the currency spot quotations that appear in *The Wall Street Journal*. Most major currencies of capitalist countries are included, although many of these currencies do not freely float with other

EXHIBIT 11.2 | Spot and Forward Exchange Rates

CURRENCY TRADING

Monday, March 25, 2002

EXCHANGE RATES

The New York foreign exchange mid-range rates below apply to trading among banks in amounts of \$1 million and more, as quoted at 4 p.m. Eastern time by Reuters and other sources. Retail transactions provide fewer units of foreign currency per dollar.

Country	U.S. \$ EQUIV.		CURRENCY PER U.S. \$	
	Mon	Fri	Mon	Fri
Argentina (Peso)-y.....	.2941	.3350	3.4000	2.9850
Australia (Dollar).....	.5303	.5308	1.8859	1.8841
Bahrain (Dinar).....	2.6525	2.6525	.3770	.3770
Brazil (Real).....	.4228	.4235	2.3650	2.3615
Britain (Pound).....	1.4257	1.4255	.7014	.7015
1-month forward.....	1.4229	1.4228	.7028	.7028
3-months forward.....	1.4181	1.4179	.7052	.7053
6-months forward.....	1.4115	1.4113	.7085	.7086
Canada (Dollar).....	.6310	.6338	1.5847	1.5777
1-month forward.....	.6309	.6337	1.5851	1.5781
3-months forward.....	.6304	.6332	1.5863	1.5793
6-months forward.....	.6297	.6323	1.5881	1.5815
Chile (Peso).....	.001492	.001496	670.15	668.45
China (Renminbi).....	.1208	.1208	8.2769	8.2770
Colombia (Peso).....	.0004400	.0004408	2272.50	2268.50
Czech Rep. (Koruna).....	.02825	.02817	35.395	35.499
Commercial rate.....	.1181	.1180	8.4705	8.4765
Denmark (Krone).....	1.0000	1.0000	1.0000	1.0000
Ecuador (US Dollar)-e.....	.1282	.1282	7.7995	7.7996
Hong Kong (Dollar).....	.003594	.003592	278.21	278.39
Hungary (Forint).....	.02051	.02051	48.750	48.750
India (Rupee).....	.0001030	.0001018	9705	9825
Indonesia (Rupiah).....	.2139	.2154	4.6750	4.6435
Israel (Shekel).....	.007497	.007530	133.38	132.81
1-month forward.....	.007510	.007541	133.15	132.50
3-months forward.....	.007535	.007567	132.72	132.16
6-months forward.....	.007585	.007617	131.84	131.28
Jordan (Dinar).....	1.4104	1.4104	.7090	.7090

Country	U.S. \$ EQUIV.		CURRENCY PER U.S. \$	
	Mon	Fri	Mon	Fri
Kuwait (Dinar).....	3.2510	3.2573	.3076	.3070
Lebanon (Pound).....	.0006504	.0006504	1514.25	1514.25
Malaysia (Ringgit)-b.....	.2632	.2632	3.8001	3.8001
Malta (Lira).....	2.1997	2.1986	.4546	.4548
Mexico (Peso).....				
Floating rate.....	.1110	.1105	9.0075	9.0460
New Zealand (Dollar).....	.4381	.4385	2.2826	2.2805
Norway (Krone).....	.1139	.1139	8.7770	8.7806
Pakistan (Rupee).....	.01666	.01666	60.025	60.025
Peru (new Sol).....	.2895	.2894	3.4533	3.4550
Philippines (Peso).....	.01956	.01956	51.125	51.115
Poland (Zloty).....	.2416	.2433	4.1390	4.1100
Russia (Ruble)-a.....	.03210	.03207	31.157	31.182
Saudi Arabia (Riyal).....	.2666	.2666	3.7504	3.7506
Singapore (Dollar).....	.5438	.5454	1.8390	1.8335
Slovak Rep. (Koruna).....	.02101	.02098	47.607	47.657
South Africa (Rand).....	.0866	.0871	11.5455	11.4800
South Korea (Won).....	.0007539	.0007556	1326.50	1323.40
Sweden (Krona).....	.0974	.0973	10.2679	10.2767
Switzerland (Franc).....	.6004	.6000	1.6655	1.6667
1-month forward.....	.6006	.6001	1.6651	1.6663
3-months forward.....	.6009	.6005	1.6642	1.6654
6-months forward.....	.6019	.6014	1.6614	1.6628
Taiwan (Dollar).....	.02857	.02858	35.000	34.990
Thailand (Baht).....	.02305	.02304	43.385	43.395
Turkey (Lira)-f.....	.00000074	.00000074	1345000	1344000
United Arab (Dirham).....	.2722	.2723	3.6731	3.6730
Uruguay (Peso).....	.06711	.06689	14.900	14.950
Venezuela (Bolivar).....	.001117	.001123	895.50	890.63
SDR.....	1.2483	1.2506	.8011	.7996
Euro.....	.8776	.8770	1.1395	1.1403

Special Drawing Rights (SDR) are based on exchange rates for the U.S., British, and Japanese currencies. Source: International Monetary Fund.
a-Russian Central Bank rate. b-Government rate. y-Floating rate.

Source: From *The Wall Street Journal*, March 26, 2002, p. B15. Copyright © 2002 Dow Jones. Reprinted by permission of Copyright Clearance Center.

currencies. In these cases, the exchange rates are established either by government order or by the country's central bank, which intervenes to keep the exchange rate at a given level. Note that quotes for a spot and several forward rates are included for most major trading partners of the United States.

For the example day—Monday, March 25, 2002—the spot price of the British pound was \$1.4257, which means that 1 million British pounds are equivalent to £1,000,000 ($\$1.4257/\pounds$) = \$1,425,700. In the third column the same quote is inverted, that is, expressed as units of British currency per U.S. dollar; \$1 million is equivalent to \$1,000,000 ($\pounds0.7014/\$$) = £701,400. On that same day, the one-month forward rate for pounds was \$1.4229, which means that one could have entered into an agreement to buy £1,000,000 in one month at a price of \$1,422,900. Of course, these quotes should not be interpreted as precise because they are based on a sampling of banks and represent large transactions. Moreover, the bid-ask spread does not appear in these quotes.

FUTURES CONTRACTS

A futures contract is much like a forward contract in some ways. As with a forward, a futures contract obliges the owner to purchase the underlying asset at a specified price

(the exercise price or futures price) on a specified day. The long (short) futures payoff profile is identical to the long (short) forward payoff profile shown in Exhibit 11.1. Futures, however, have two major distinctions that differentiate them from forwards.

First, futures have *less liquidity risk* because they are traded on major futures exchanges. Futures contracts have standardized terms and conditions, such as quality and quantity of the underlying asset and expiration dates. This standardization allows futures to be bought and sold in secondary markets, just like common stocks. Someone purchasing (or selling) a futures contract can offset her obligation by selling (or purchasing) the identical type of contract.

Second, futures have *less credit risk* or default risk than forwards. Purchasers and sellers of futures are required to deposit funds, the initial margin, in a margin account with the exchange's clearing corporation or clearinghouse. The initial margin requirement is usually 3 percent to 6 percent of the value of the contract. Funds are added to or subtracted from the margin account daily, reflecting that day's price changes in the futures contract (at the end of each trading day, a special exchange committee determines the approximate closing price, called the settlement price, for each futures contract). Thus, futures are cash-settled every day through this process known as *marking to the market*. Similar to common stocks, if an investor's margin account becomes too low, the maintenance margin limit is reached and the investor must place additional funds in the margin account or have his position closed.

Thus, rather than buying or selling futures from a specific investor, the futures exchange becomes the counterparty to all transactions. Should an investor default, the exchange, rather than a specific investor, covers any losses. But the daily settling of accounts through marking to the market and the maintenance margin requirements helps to prevent an investor's deficit from growing unchecked until contract maturity.

Parties that cannot deposit the funds required on a daily basis will have their contracts liquidated. Thus, some have compared futures contracts to "a series of forward contracts [in which] each day yesterday's contract is settled and today's contract is written."² That is, a futures contract is like a forward contract that was purchased yesterday, expires today, and is replaced with a new one-day forward contract priced to reflect today's expectations. Today's contract expires tomorrow, at which time settlement occurs (the function of daily settling by marking to the market) and a new one-day forward is created at a price reflecting tomorrow's expectations, and so on.

Although the Chicago Board of Trade is the oldest futures exchange, many other futures exchanges operate in the United States and in the rest of the world. Exhibit 11.3 lists the U.S. futures exchanges and provides a few details about them. The Chicago Board of Trade (CBOT) remains the largest futures exchange, but it is rivaled by the Chicago Mercantile Exchange (CME). Although the CBOT specializes in grains, its biggest contract is its highly successful U.S. Treasury bond futures, which was launched in 1977 and has traditionally experienced the largest volume of any futures contract. The CME originally specialized in livestock futures, but most of its current volume comes from numerous successful futures on foreign currencies, stock indexes, and the Eurodollar. The third largest exchange is the New York Mercantile Exchange (NYMEX), which specializes in futures on energy products such as crude oil, gasoline, and heating oil. Trading in these contracts has exploded in recent years because

²Fischer Black, "The Pricing of Commodity Contracts," *Journal of Financial Economics* 3, nos. 1, 2 (January-March 1976): 167-179.

EXHIBIT 11.3 Global Futures Exchanges

- Chicago Board of Trade (CBOT)** Referred to as "The Board of Trade." The world's oldest and largest futures exchange. The primary exchange for futures on agricultural commodities and a major market for trading in financial futures, particularly on intermediate and long-term Treasury securities.
- Chicago Mercantile Exchange (CME)** Referred to as "The Merc." The second largest futures exchange. Originally specialized in livestock futures, but now most trading is in stock-index, interest rate, and foreign currency futures through its subsidiaries the Index and Option Market and the International Monetary Market.
- Coffee, Sugar, and Cocoa Exchange (CSCE)** Located in New York. Specializes in coffee, sugar, and cocoa.
- Commodity Exchange (COMEX)** Referred to as "Comex." The primary market for metal futures.
- Kansas City Board of Trade (KCBT)** Specializes in grain and has a small volume in stock-index futures. It was the first exchange to offer trading in stock index futures.
- London International Financial Futures Exchange (LIFFE)** Offers trading in interest rate and equity futures, options, swaps, and selected commodities including cocoa, sugar, and wheat.
- Marche a Terme International de France (MATIF)** Offers trading in short-term, medium-term, and long-term Eurobond futures; selected stock-index futures; and commodities.
- MidAmerica Commodity Exchange (MCE)** Referred to as "The MidAm." Trades scaled-down versions of many of the contracts on the Chicago Board of Trade and Chicago Mercantile Exchange.
- Minneapolis Grain Exchange (MGE)** Small volume of trading in grain futures.
- New York Cotton Exchange (NYCTN)** Specializes in cotton and orange juice. Orange juice trades on its subsidiary the Citrus Associates and has a small volume of trading in currency and financial futures on its subsidiary the Financial Instruments Exchange (FINEX).
- New York Futures Exchange (NYFE)** Referred to as "NYFE" (pronounced "Nife"). Created out of the New York Stock Exchange. Specializes in stock-index futures and has a small volume of trading in a commodity futures index and in Treasury bond futures.
- New York Mercantile Exchange (NYMEX)** Referred to as "NYMEX." The primary market for energy futures.
- Philadelphia Board of Trade (PBT)** Created out of the Philadelphia Stock Exchange. Has a small volume of trading in currency futures. In June 1998 it agreed to a merger with the American and Nasdaq exchanges, to occur during a five-year transition period.
- Twin Cities Board of Trade (TCBT)** Created out of the Minneapolis Grain Exchange. Has a small volume of trading in currency futures.

NYMEX's contracts have enabled firms to hedge the extremely volatile energy market. A listing of some of the more popular contracts and their exchanges is provided in Exhibit 11.4.

How do futures contracts develop? As part of their marketing function, the futures exchanges develop futures contracts for outstanding assets (for example, commodities, bonds) that they believe will meet the needs of various traders and investors. In late 1997, futures trading began on two new futures contracts that may be of interest to individual and institutional investors. One, called the "mini" S&P 500 futures, allows futures trading on a contract that is one-tenth the value of the regular S&P 500 futures contract. The second allows futures trading on the value of the Dow Jones Industrial Average, one of the world's best-known stock-market indexes.

Exhibit 11.5 presents a sample of the futures quotation page from *The Wall Street Journal*. For example, a corn futures contract trades at the Chicago Board of Trade (CBT in *The Wall Street Journal*) and trades in units of 5,000 bushels. The price quoted is in cents per bushel. The September 2002 contract (on the eighth line of the left-hand column) opened at $248\frac{1}{4}$ cents per bushel, had a high of $249\frac{1}{2}$ cents per bushel, and a low of 247 cents per bushel. The settlement price, which is roughly the closing price and the price at which contracts are marked to market, was 249 cents per bushel. The settlement price was down by $\frac{1}{4}$ cent per bushel from the previous day. During the lifetime of the September 2002 contract, its high was 262 and its low was 233. The open

EXHIBIT 11.4 Popular Futures Contracts and Exchanges

Underlying Asset	Exchange
A. Physical Commodities	
Corn, soybeans, soybean meal, soybean oil, wheat	Chicago Board of Trade
Cattle—feeder, cattle—live, hogs, pork bellies	Chicago Mercantile Exchange
Lumber	
Heating oil	
Cocoa, coffee, sugar—world, sugar—domestic	Cocoa, Sugar, and Coffee Exchange
Copper, gold, silver	New York Commodity Exchange
Crude oil, heating oil, gasoline, natural gas	New York Mercantile Exchange
Platinum	
B. Financial Securities	
Yen, Euro, Canadian dollar, Swiss franc, British pound, Mexican peso, Australian dollar, Treasury bills, Eurodollar (LIBOR), mini S&P 500, S&P 500 Index, Nikkei 225 Index, Russell 2000 Index	International Monetary Market (Chicago Mercantile Exchange)
Treasury bonds, Treasury notes, Municipal bond index, federal funds, Dow Jones Industrial Average Major Market Index	Chicago Board of Trade
Eurodollar, British gilt, German bunds Euromarks, Eurofrancs, Euroaira FT-SE 100 Index	London International Financial Futures Exchange

interest—the number of contracts currently outstanding—was 1,274. At the bottom of each commodity listing is summary information on the overall volume, the volume on the previous day, and the overall open interest for the commodity.

The upper right-hand column of the exhibit contains the stock-index futures contracts. For instance, S&P 500 futures trades at the Chicago Mercantile Exchange (CME) and its price is 250 times the index. The March 2002 contract opened at 1200.10, which means the value of the contract was actually $\$250 \times 1200.10$ or $\$300,025$. The high during the day was 1208.30, the low was 1194.30, and the settlement price was 1194.50, down 11.80 from the previous day. During its lifetime, the March contract had a high of 1349.60 and a low of 1186.80. Its open interest was 1,339 contracts. At the bottom of the S&P 500 listing is information on volume and open interest and about the actual S&P 500 index, which closed at 1178.02 on August 15, 2001.

The lower right-hand column of the exhibit contains information on interest rate futures. For example, the Treasury bond contract on the Chicago Board of Trade is for \$100,000 face value of Treasury bonds and the price quote is in $\frac{1}{32}$ of 100 percent of face value. The settlement price of the September 2001 contract is $103\frac{30}{32}$, down $\frac{4}{32}$ from the previous day. This is an actual price of $(103\frac{30}{32}) \times \$100,000 = \$103,937.50$. The rightmost column of the exhibit contains the open interest, and the bottom line below the Treasury bond futures listing contains volume and open interest information on all contracts.

In 1972, the Chicago Mercantile Exchange began trading futures based on the currencies of the leading trading partners of the United States. The currency futures market is quite active, although it is smaller than the over-the-counter currency forward market. Current trading is in the Japanese yen, Canadian dollar, British pound, Swiss franc, Australian dollar, Mexican peso, and the euro. The most active trading is in the yen and euro contracts.

EXHIBIT 11.5 Selected Futures Prices

Wednesday, August 15, 2001

Open Interest Reflects Previous Trading Day.

GRAINS AND OILSEEDS							LIFETIME		OPEN
	OPEN	HIGH	LOW	SETTLE	CHANGE	HIGH	LOW	INT.	
Corn (CBT) 5,000 bu., cents per bu.									
Sept	221½	222½	218	219½	- 2¼	276½	192	95,644	
Nov	226¼	229	226½	227¾	- 2	242½	199	204	
Dec	233¼	235	230	231¼	- 2¼	275	202¼	214,282	
Jan02	236	237	234	235½	- 2½	243	213½	397	
Mar	243¼	244¼	240	241¼	- 2	270	205	41,955	
May	247	248	243¾	245¼	- 2	266½	221	11,579	
July	251½	251¾	249	250	- 1½	279½	227¼	15,728	
Sept	248¼	249½	247	249	- ¼	282	233	1,274	
Dec	253½	253¾	251	252¾	.....	272	239¾	12,905
Jan03	287	288	286	286	.....	272	260	51
Dec	283	284¼	282	284¼	+ ¾	269	253½	1,081	
Est vol 88,000; vol Tue 54,079; open int 395,100, +750.									
Oats (CBT) 5,000 bu., cents per bu.									
Sept	133½	134¼	130¼	131¼	- 1¾	154½	103¼	4,179	
Dec	134	134¼	131½	133	- 1¼	146¼	108½	5,609	
Mar02	136¼	138	136	137¼	- 1	144½	114½	2,182	
Est vol 1,200; vol Tue 268; open int 12,183, -66.									
Soybeans (CBT) 5,000 bu., cents per bu.									
Sept	511	519	505½	517½	+ 6¼	549	414½	18,675	
Nov	507¼	515½	502½	513	+ 5½	605	417½	91,815	
Jan02	512	519	507	516¾	+ 4½	540	427¼	14,278	
Mar	517	521½	511	520	+ 5	546	436½	14,174	
May	513	518	507½	517	+ 4½	531	444	17,733	
July	504½	506¼	502½	505¼	- 2¼	355	272	3,886	
Dec	322	322	318	320½	- 2½	365	317	800	
Est vol 27,000; vol Tue 15,112; open int 144,699, -173.									
Wheat (KC) 5,000 bu., cents per bu.									
Sept	298¼	298¼	292½	294½	- 3	365½	292½	37,393	
Dec	313	313¼	307	309¾	- 2½	375	307	35,149	
Mar02	325	325½	320	322½	- 2	383	320	9,912	
May	330	330	327½	329	- 1½	357	327½	993	
Est vol 19,763; vol Tue 6,585; open int 83,623, -567.									
Wheat (MPLS) 5,000 bu., cents per bu.									
Sept	305	305¼	301	305¼	+ ¼	391	301	12,143	
Dec	320¼	320¼	315	319½	+ ¼	389	315	8,843	
Mar02	332½	333½	328¼	333½	+ 1	387	328¼	2,001	
May	341	341	337	340¼	+ ¼	376	337	219	
Est vol 4,834; vol Tue 3,623; open int 23,293, -155.									
Sept	18.92	19.00	18.70	18.88	- .07	21.15	14.79	28,211	
Oct	18.88	19.14	18.88	19.03	- .06	20.35	14.94	20,526	
Dec	19.26	19.75	19.17	19.32	- .11	21.25	15.22	74,223	
Jan02	19.50	19.62	19.35	19.45	- .12	20.02	15.43	17,184	
Mar	19.69	19.80	19.55	19.65	- .12	20.15	15.72	9,408	
May	19.85	20.00	19.75	19.83	- .15	20.30	16.00	11,317	
July	20.20	20.20	19.95	20.07	- .10	20.55	16.30	5,382	
Aug	.....	.....	.....	19.80	- .37	20.33	17.30	798
Sept	.....	.....	.....	19.80	- .37	17.50	16.90	656
Oct	.....	.....	.....	19.70	- .35	18.35	17.60	265
Dec	.....	.....	.....	20.62	+ .12	20.50	17.10	860
Est vol 13,500; vol Tue 17,733; open int 168,224, +1,667.									
Wheat (CBT) 5,000 bu., cents per bu.									
Sept	268¼	269½	263	266½	- 2¼	325	254	43,644	
Dec	283½	284¼	278	282	- 2¼	343	253	69,886	
Mar02	296¼	298	292	295¼	- 2	346	283	24,293	
May	302	302½	298½	301½	- 1¼	326	291½	2,166	
July	304½	306¼	302½	305¼	- 2¼	355	272	3,886	
Dec	322	322	318	320½	- 2½	365	317	800	
Est vol 27,000; vol Tue 15,112; open int 144,699, -173.									
Wheat (KC) 5,000 bu., cents per bu.									
Sept	298¼	298¼	292½	294½	- 3	365½	292½	37,393	
Dec	313	313¼	307	309¾	- 2½	375	307	35,149	
Mar02	325	325½	320	322½	- 2	383	320	9,912	
May	330	330	327½	329	- 1½	357	327½	993	
Est vol 19,763; vol Tue 6,585; open int 83,623, -567.									
Wheat (MPLS) 5,000 bu., cents per bu.									
Sept	305	305¼	301	305¼	+ ¼	391	301	12,143	
Dec	320¼	320¼	315	319½	+ ¼	389	315	8,843	
Mar02	332½	333½	328¼	333½	+ 1	387	328¼	2,001	
May	341	341	337	340¼	+ ¼	376	337	219	
Est vol 4,834; vol Tue 3,623; open int 23,293, -155.									

OPEN HIGH LOW SETTLE CHANGE LIFETIME HIGH LOW OPEN INT.

INDEX									
DJ Industrial Average (CBOT)-\$10 times average									
Sept	10434	10487	10350	10358	- 74	11448	8240	31,515	
Dec	10459	10525	10405	10407	- 74	11950	9550	1,400	
Est vol 13,300; vol Tue 12,022; open int 32,924, +239.									
Ibx prt: Hi 10469.74; Lo 10340.76; Close 10345.95, -66.22.									
S&P 500 Index (CME)-\$250 times index									
Sept	119250	119520	117950	118380	- 1150	169080	110650	445,472	
Dec	119850	120200	118700	118770	- 1160	171480	110900	49,336	
Mar02	120010	120830	119400	119450	- 1160	134950	118680	1,339	
June	.....	.....	.....	120400	.....	1160	170550	112900	
Sept	.....	.....	.....	121380	.....	1200	165070	114000	
Dec	.....	.....	.....	122480	.....	1200	150070	115100	
Est vol 62,110; vol Tue 55,936; open int 497,110, +1,581.									
Ibx prt: Hi 1191.21; Lo 1177.81; Close 1178.02, -8.71.									
Mini S&P 500 (CME)-\$50 times index									
Sept	119250	119525	117950	118075	- 1150	133500	110925	121,828	
Vol Tue 135,536; open int 121,915, +4,238.									
S&P Midcap 400 (CME)-\$500 times index									
Sept	506.00	508.00	500.50	503.70	- 3.05	575.00	443.00	16,323	
Est vol 1,042; vol Tue 887; open int 16,323, -25.									
Ibx prt: Hi 505.46; Lo 499.61; Close 502.75, -1.19.									
Nikkei 225 Stock Average (CME)-\$5 times index									
Sept	11650.	11725.	11585.	11620.	- 250	16340.	11295.	18,568	
Est vol 833; vol Tue 1,565; open int 18,628, +380.									
Ibx prt: Hi 11923.92; Lo 11648.88; Close 11755.40, -162.55.									
Nasdaq 100 (CME)-\$100 times index									
Sept	163700	164900	157400	157680	- 5800	281500	139500	55,785	
Est vol 15,324; vol Tue 14,790; open int 55,898, -458.									
Ibx prt: Hi 1641.84; Lo 1571.92; Close 1572.03, -57.92.									
Mini Nasdaq 100 (CME)-\$20 times index									
Sept	1638.0	1649.0	1574.0	1576.5	- 58.0	2899.5	1413.5	128,465	
Vol Tue 113,108; open int 126,462, +1,401.									
GCX (CME)-\$250 times nearby index									
Aug	208.90	209.80	208.90	207.59	+ .09	226.70	196.50	301	
Sept	208.40	208.50	206.75	207.45	+ .25	208.50	197.90	14,328	
Est vol 235; vol Tue 6,014; open int 14,629, -344.									
Ibx prt: Hi 208.56; Lo 204.87; Close 207.51, +20.									
Russell 2000 (CME)-\$500 times index									
Sept	481.75	483.75	476.75	480.60	- 2.50	554.60	434.30	20,914	
Est vol 2,376; vol Tue 1,576; open int 20,914, -185.									
Ibx prt: Hi 481.19; Lo 476.50; Close 478.95, -1.24.									

INTEREST RATE

Treasury Bonds (CBT)-\$100,000; pts 32nds of 100%									
Sept	104-02	104-11	103-17	103-30	-	4 106-25	96-22	471,836	
Dec	103-12	103-18	102-25	103-06	-	4 104-24	97-25	51,178	
Est vol 197,000; vol Tue 157,893; open int 523,292, -853.									
Treasury Notes (CBT)-\$100,000; pts 32nds of 100%									
Sept	06-045	106-10	05-255	05-305	-	8.5 106-28	101-26	562,589	
Dec	05-085	05-175	05-02	05-065	-	8.5 105-21	100-26	57,469	
Est vol 210,000; vol Tue 163,010; open int 620,058, +11,521.									
10 Yr Agency Notes (CBT)-\$100,000; pts 32nds of 100%									
Sept	101-16	101-23	101-03	01-065	-	10.0 02-035	97-145	48,788	
Est vol 660; vol Tue 976; open int 48,792, -441.									
5 Yr Treasury Notes (CBT)-\$100,000; pts 32nds of 100%									
Sept	105-20	05-235	105-11	05-135	-	6.5 105-26	101-03	460,758	
Dec	105-11	105-11	105-01	05-025	-	6.5 105-15	103-17	23,080	
Est vol 93,000; vol Tue 75,338; open int 483,838, +4,448.									
2 Yr Treasury Notes (CBT)-\$200,000; pts 32nds of 100%									
Sept	103-24	103-25	03-192	103-21	-	3.7 103-29	02-085	65,448	
Est vol 9,000; vol Tue 5,757; open int 70,201, +3,130.									
30 Day Federal Funds (CBT)-\$5 million; pts of 100%									
Aug	96.355	96.360	96.350	96.355	-	010	96.455	26,280	
Sept	96.53	96.54	96.51	96.52	-	03	96.55	50,334	
Oct	96.66	96.66	96.61	96.62	-	04	96.69	95,622	
Nov	96.69	96.70	96.63	96.66	-	05	96.73	98,08	
Dec	96.70	96.72	96.66	96.68	-	05	96.75	96,35	
Jan02	96.72	96.72	96.66	96.67	-	06	96.76	96,22	
Feb	.....	.....	.....	96.63	-	06	96.69	96,05
Mar	.....	.....	.....	96.54	-	06	95.59	96,05
Apr	.....	.....	.....	96.48	-	06	95.55	95,70
Est vol 25,000; vol Tue 14,220; open int 168,298, +4,201.									
Muni Bond Index (CBT)-\$1,000; times Bond Buyer MBI									
Sept	106-30	107-03	106-28	-	-	1 107-03	100-12	11,721	
Est vol 1,500; vol Tue 521; open int 11,736, +98.									
Index: Close 106-21; Yield 5.25.									
Treasury Bills (CME)-\$1 mil.; pts of 100%									
Sept	96.74	96.74	96.72	96.72	-	03	3.28	+03	
Est vol 12; vol Tue 2; open int 2,333, unch.									
Libor-1 Mo. (CME)-\$3,000,000; pts of 100%									
Sept	96.51	96.51	96.48	96.48	-	03	3.62	+03	
Oct	96.59	96.59	96.55	96.55	-	04	3.45	+04	
Nov	96.59	96.59	96.57	96.57	-	04	3.43	+04	
Dec	96.30	96.32	96.30	96.32	-	06	3.68	+06	
Feb02	.....	.....	.....	96.44	-	06	3.56	+06
Est vol 3,341; vol Tue 2,395; open int 18,767, -14,087.									

Source: From *The Wall Street Journal*, August 16, 2001, p. C14. Copyright © 2001 Dow Jones. Reprinted by permission of Copyright

Exhibit 11.6 presents a sample of the quotations from *The Wall Street Journal* for currency futures. For example, a yen contract is for 12.5 million yen, with the settlement price of the September 2002 yen contract equal to 0.7581. However, because there are so many yen in a dollar, it is understood that two decimal places precede the price. Thus, the actual price is \$.007581 per yen. For a full contract, the price is $\text{¥}12,500,000 \times \$.007581/\text{¥} = \$94,762.5$.

The use of futures contracts in investment portfolios is widespread among professional managers. Cash inflows to an equity portfolio can be used to purchase S&P 500 futures to prevent the cash from diluting the portfolio's equity exposure. Because of the use of margin, only a fraction of the cash inflows need to be invested to maintain the appropriate equity exposure for the portfolio. After suitable stocks for investment are selected, the futures positions are sold and the excess cash is invested in the selected securities. Futures can be used to assist an indexing strategy and to adjust portfolio asset allocation quickly. Equity and bond futures can be traded to immediately tilt a portfolio toward the preferred asset class. Then, over time, asset positions can be liquidated and new securities purchased while the futures positions are unwound.

OPTIONS

As described earlier, an option grants an investor the right to buy or sell an asset at a fixed price on or before a specific point in time. An option to buy an asset is referred to as a *call option*, whereas an option to sell an asset is called a *put option*. Buyers of options (either calls or puts) are said to be *long* and sellers are said to be *short*.

EXHIBIT 11.6 Currency Futures Prices

	OPEN	HIGH	LOW	SETTLE	CHANGE	LIFETIME		OPEN INT.
						HIGH	LOW	
CURRENCY								
Japan Yen (CME)-12.5 million yen; \$ per yen (.00)								
June	.7558	.7570	.7525	.7534	-.0028	.8776	.7449	69.986
Sept	.7579	.7616	.7574	.7581	-.0028	.8620	.7495	560
Est vol 4,474; vol Fri 10,537; open int 70,978, -554.								
Canadian Dollar (CME)-100,000 dls.; \$ per Can \$								
June	.6330	.6334	.6297	.6312	-.0023	.6700	.6180	56,078
Sept	.6300	.6315	.6292	.6305	-.0023	.6590	.6175	3,542
Dec	.6290	.6305	.6285	.6299	-.0023	.6555	.6190	1,449
Mar03	.6288	.6288	.6280	.6293	-.0023	.6392	.6198	229
June	.6280	.6280	.6280	.6287	-.0023	.6325	.6197	148
Est vol 5,629; vol Fri 10,815; open int 61,446, +128.								
British Pound (CME)-62,500 pds.; \$ per pound								
June	1.4180	1.4212	1.4160	1.4188	+.0006	1.4550	1.3910	24,932
Sept	1.4114	1.4144	1.4094	1.4112	+.0006	1.4186	1.3990	940
Est vol 1,404; vol Fri 4,203; open int 25,872, -678.								
Swiss Franc (CME)-125,000 francs; \$ per franc								
June	.6000	.6016	.5995	.6006	+.0004	.6320	.5813	31,512
Sept	---	---	---	.6016	+.0004	.6110	.5860	365
Est vol 1,373; vol Fri 15,769; open int 31,912, -2,418.								
Australian Dollar (CME)-100,000 dls.; \$ per A.\$								
June	.5266	.5298	.5265	.5272	-.0005	.5310	.4885	38,999
Est vol 825; vol Fri 3,874; open int 39,116, +242.								
Mexican Peso (CME)-500,000 new Mex. peso, \$ per MP								
June	.10900	.10950	.10893	.10948	+.00062	.10950	.09730	35,900
Sept	.10750	.10780	.10750	.10780	+.00057	.10780	.09930	2,200
Dec	.10640	.10640	.10640	.10638	+.00052	.10640	.09650	782
Est vol 3,062; vol Fri 1,900; open int 39,088, -155.								
Euro FX (CME)-Euro 125,000; \$ per Euro								
June	.8739	.8752	.8724	.8743	+.0005	.9275	.8365	98,808
Sept	.8705	.8726	.8703	.8720	+.0005	.9235	.8375	1,316
Dec	.8707	.8707	.8707	.8704	+.0005	.9175	.8390	288
Est vol 5,073; vol Fri 27,991; open int 100,424, +1,359.								

The price paid for the option itself is called the option premium. The price at which the asset can be acquired or sold is the *exercise price* or *strike price*. For example, if a stock call option has an exercise price of \$45, it means that this call option permits the owner of the option to buy the stock for \$45 a share. If the underlying stock's current market price is \$50, the call option has an intrinsic value of \$5 as it allows the holder to pay \$45 for something that has a market value of \$50. If the underlying stock's price is \$40, the call option's intrinsic value is \$0; it is worthless, and the holder will choose not to exercise the option as it makes little sense to pay \$45 (the exercise price) for something that has a spot-market value of \$40.

Similarly, suppose a put option permits its owner to sell the stock for \$45 a share. If the underlying stock's current market price is \$40, the put option has an intrinsic value of \$5 as it allows the holder to sell for \$45 an asset that has a market value of only \$40. If the underlying stock's price is \$50, the put option's intrinsic value is \$0; it is worthless, and the holder will choose not to exercise the option as it makes little sense to sell an asset for \$45 (the exercise price) when he can go to the spot market and sell it for \$50.

The put option contract can be viewed as insurance for an asset that is owned by the investor. The insurance premium is the option premium. Paying the premium protects the owner against a decline in value (up to the strike price) of the asset. Later in the chapter we will see how options can be used to hedge, or insure, against the risk of price declines of already owned assets.

The date on which the option expires, or the last date on which it can be exercised, is the *expiration date*. For options trading on exchanges, expiration dates are typically specified in terms of a given month, and the time within the month is likewise specified as the Saturday following the third Friday. Thus, a July option would expire the Saturday following the third Friday in July. However, off the exchanges, options can be created by any two parties and can have any expiration date desired. Options that trade on exchanges are generally fairly liquid so that they can be sold before expiration. Few options are exercised; in-the-money options are usually closed out before the expiration date, giving the holder a profit on the difference between the premium paid for the option and the premium received when it is sold.

Some options permit the holder to exercise them only on the expiration day. These are called European options. Those that permit the holder to exercise any time up to and including the expiration day are called American options. These names have no relationship to geography; both European and American options trade extensively on exchanges and in over-the-counter markets in both the United States and Europe as well as other parts of the world.

For both puts and calls, an *at-the-money* option means that the stock price is approximately equal to the exercise price. An *in-the-money* option has some intrinsic value in and of itself; the exercise price allows the holder to purchase an asset below current market value or sell an asset at a price above its current market value. An *out-of-the-money* option has no intrinsic value and will not be exercised because the holder can buy the stock for less in the market (*out-of-the-money* call) or sell it for more (*out-of-the-money* put). However, an *out-of-the-money* option can subsequently become in the money and vice versa prior to expiration.

Exhibit 11.7 summarizes some option-contract terminology. Exhibit 11.8 summarizes some of the major distinctions between forward, futures, and option contracts.

Option Exchanges

In 1973, the Chicago Board of Trade (CBOT)—the largest futures exchange at the time—created a separate exchange called the Chicago Board Options Exchange (CBOE).

EXHIBIT 11.7 Important Options Terminology

Term	Definition
Call option	Right to purchase an asset at a specific price on or before a specific date
Put option	Right to sell an asset at a specific price on or before a specific date
Option premium	Price paid by the investor to purchase the option contract
Exercise or strike price	Price at which the underlying asset can be bought or sold
Expiration date	Date on which the option to exercise the contract expires
Write an option	Sell an option contract
At the money	Exercise price is the same as the underlying asset spot price
In the money	The option has some positive intrinsic value; trading at the exercise price is more attractive to the option holder than trading at the market price for the underlying asset. For calls, asset spot price exceeds exercise price; it is cheaper to buy the asset at the exercise price. For puts, asset spot price is less than exercise price; more is gained by selling the asset at the exercise price
Out of the money	The option has no intrinsic value; trading at the spot price is more attractive to the option holder rather than trading at the exercise price. For calls, asset spot price is less than exercise price; it is cheaper to buy the asset at the spot price. For puts, asset spot price exceeds exercise price; more is gained by selling the asset at the spot price.

EXHIBIT 11.8 Differences between Forwards, Futures, and Options

Forward Contract	Futures Contract	Option Contract
Obligation to trade at time T at a specified price	Obligation to trade at time T at a specified price	Option to trade at time T at a specified price
Traded OTC	Exchange traded	Exchange traded
Terms are not standardized	Standardized terms	Standardized terms
Poor secondary market (not liquid)	Liquid (varies among contracts)	Liquid (varies among contracts)
Settlement occurs at expiration	Daily settlement (marking to the market)	Daily settlement
Close long position by selling identical contract to another party or to the original seller	Close long position by selling the contract on the exchange	Close long position by selling the contract on the exchange
Exposed to credit/default risk by the counterparty	No credit/default risk	No credit/default risk
Can earn a profit or loss in a long position	Can earn a profit or loss in a long position	Can limit losses by choosing not to exercise the option

The CBOE became a centralized facility for trading standardized option contracts. Specifically, the CBOE offered the following features:

1. A central marketplace with regulatory, surveillance, disclosure, and price dissemination capabilities.
2. The Clearing Corporation as the guarantor of every CBOE option. Standing as the opposite party to every trade, the Clearing Corporation enables buyers and sellers of options to terminate their positions in the market at any time by making an off-setting transaction.
3. Standardized expiration dates. CBOE options have specific expirations. All stocks are classified into one of three cycles: the January cycle (January, April, July, and October), the February cycle (February, May, August, and November), and the March cycle (March, June, September, and December). Each stock's options have

- an expiration in the current month, the next month, and the next two months in one of these three cycles. The options expire on the Saturday following the third Friday of the month. In recent years, the CBOE has added some long-term options, called LEAPS, that have expirations of two to three years. Options on stock indexes follow a pattern of having expiration dates over the next several consecutive months.
4. Standardized exercise prices. Options are available with exercise prices that bracket the current stock price. Exercise prices are generally set in five-dollar intervals. As a stock price moves, additional options with new exercise prices are added.
 5. Standardized contract size. Options are traded in units, called contracts, which are standardized at 100. Thus, buying one option contract is actually buying options on 100 shares. Adjustments are made for stock splits and stock dividends, which can create odd-lot option contracts.
 6. A secondary market. As a result of the standardization of expirations and exercise prices, a secondary market for options became feasible. Before option exchanges were established, the buyers and sellers of OTC options were essentially committed to their positions until the expiration date. Exchange-traded options on individual stocks are generally American options (that is, they are exercisable on any day up to and including the expiration day). However, some index options are European-style, meaning that they can be exercised only on the expiration day.

The CBOE started with options on sixteen stocks, a number that gradually increased until today the CBOE offers options on almost 1,400 stocks. Exhibit 11.9 is a description of the index options that also trade on the various exchanges. Index options have special appeal because they involve taking a position on the market as a whole, rather than on individual stocks.

Exhibit 11.10 presents a sample of the option quotation page from *The Wall Street Journal*. Let's consider buying a call option on Microsoft. Under Microsoft's name is the prior day's closing price on Microsoft stock: \$63.20. Next to Microsoft's name, in the second and third columns, are the exercise (or strike) prices and expiration dates on Microsoft option contracts. The fourth and fifth columns give the day's trading volume and the last price (or premium) for a call option contract trade; the sixth and seventh columns present the trading volume and last price (or premium) for a put option trade. If ". . ." appears under the call or put columns, it indicates that the option contract did not trade that day. Look at the last trade on the Microsoft September 65 call: The option premium is \$2.30 per share. Because each contract is for 100 calls, the total option premium cost is \$230.00. Notably, there are two potentially misleading facts about these prices. First, the closing stock price of \$63.20 and the closing option prices are not necessarily synchronized. The last trade of the day for the stock and the last trade of the day for an option on the stock may have occurred at different times.³ In addition, the prices are not identified as bid or ask prices. Thus, even if the stock and option prices were synchronized and no additional information had affected prices since the last trade, an investor might have to pay more than \$230.00. This is because the given option price quote may have represented a trade in which an investor sold an option to the CBOE market maker, which means that it would have been the bid price. Thus, an investor wanting to purchase an option from a market maker would have to pay the ask price, which would be higher.

The fact that option premiums are small, in comparison to the stock's market price, can lead to rather large percentage gains (or losses) on the option buyer's invested capital.

³In fact, the New York Stock Exchange closes at 4:00 P.M. Eastern time, whereas the CBOE closes at 4:15 P.M. Eastern time.

EXHIBIT 11-9 *Underlying Asset Options, Commodity and Index Options*

Underlying Asset	Exchange
A. Financial Securities	
Individual Equities	Chicago Board Options Exchange
S&P 100 Index, Dow Jones Industrial Average	
Yen, Canadian dollar, Swiss franc, British pound, Australian dollar	International Monetary Market (Chicago Mercantile Exchange)
S&P 500 Index, mini S&P 500	
B. Futures Options	
Cattle—feeder, cattle—live hogs, pork bellies	Chicago Mercantile Exchange
Yen, Canadian dollar, Swiss franc, British pound	International Monetary Market (Chicago Mercantile Exchange)
Eurodollar (LIBOR), 2-year Eurodollar	
S&P 500 Index	
Corn, soybeans, soybean meal, soybean oil, wheat	Chicago Board of Trade
Treasury bonds, Treasury notes	
Major Market Index	
British gilt, German bunds	London International Financial Futures Exchange
Euromark	
FT-SE 100 Index	
Crude oil, heating oil, gasoline, natural gas	New York Mercantile Exchange
Copper, gold, silver	New York Commodity Exchange

EXHIBIT 11-10 *Stock Option Options*

OPTION/STRIKE	EXP.	-CALL- VOL. LAST	-PUT- VOL. LAST	OPTION/STRIKE	EXP.	-CALL- VOL. LAST	-PUT- VOL. LAST
Intel	20 Jan	3 1060 1024	045	MicronT	30 Oct	5 830 530	150
2978	27 ⁵⁰ Aug	610 240 758	065	3645	32 ⁵⁰ Sep	...	855 130
2978	27 ⁵⁰ Sep	1484 330 595	080	3645	35 Aug	585 165 609	090
2978	30 Aug	16058 039 16108	055	3645	35 Sep	172 380 558	220
2978	30 Sep	7741 165 12241	170	3645	35 Oct	25 5 2097	320
2978	30 Oct	370 235 193	230	3645	37 ⁵⁰ Aug	1752 035 632	140
2978	32 ⁵⁰ Aug	6967 065 3798	275	3645	40 Aug	678 010 622	350
2978	32 ⁵⁰ Sep	1425 070 14521	320	3645	40 Sep	739 150 78	490
2978	35 Oct	553 065 49	580	3645	45 Sep	392 065	...
2978	35 Jan	492 170 49	630	3645	50 Oct	607 065	...
2978	50 Jan	400 015 2900	20	3645	50 Jan	413 2	...
I B M	95 Oct	...	403 2	Microst	55 Sep	35 960 394	065
10501	100 Aug	10822 520 2010	015	6320	55 Oct	...	5205 140
10501	100 Sep	1042 720 1077	160	6320	60 Aug	329 376 2242	020
10501	100 Oct	10 980 690	340	6320	60 Sep	55 540 7018	175
10501	105 Aug	1200 1 1448	1	6320	60 Oct	25 670 3431	275
10501	110 Aug	682 010 273	490	6320	60 Jan	211 3 2404	470
10501	110 Sep	211 160 557	6	6320	65 Aug	8573 069 7730	2
10501	115 Sep	4639 065 11	1010	6320	65 Sep	2968 230 949	380
10501	135 Oct	405 015	...	6320	65 Oct	451 379 2450	470
Klame	50 Sep	526 380 28	150	6320	65 Jan	1266 620 4762	670
52	55 Jan	600 390	...	6320	70 Aug	579 065 3268	660
52	60 Jan	498 220	...	6320	70 Sep	23523 075 152	730
In Pac	3750 Aug	678 4	...	6320	70 Oct	1429 175 273	770
4073	3750 Oct	873 450 3	085	6320	70 Jan	474 410 179	970
4073	40 Jan	4 4 763	265	6320	75 Sep	397 020	...
Intersil	40 Aug	639 065 257	230	6320	75 Oct	2901 080 36	12
Intertan	1250 Sep	100 066 450	180	6320	75 Jan	2091 255 13	1330
JDS Uni	790 Aug	622 1 619	016	6320	80 Jan	1139 180	...
832	750 Sep	3047 140 165	040	6320	85 Oct	1637 015	...
832	10 Sep	852 035 258	2	6320	90 Oct	514 010 8	2620
JP MorgCh	40 Aug	78 235 409	015	6320	100 Jan	74 015 504	3610
4215	45 Aug	21 005 375	285	6320	105 Jan	...	500 4110
45	45 Sep	1487 070 12	350	MMM	110 Aug	202 135 470	115
Jabil	25 Sep	127 320 422	235	Miraat	35 Sep	412 025	...
JHFA Srv	40 Sep	351 160 700	145	MSDWdis	55 Aug	95 095 801	085
JohnJn	55 Aug	643 180 337	015	5495	55 Sep	162 340 2843	3
57	55 Oct	1290 370 77	145	5495	60 Aug	16 010 2439	5
57	57 ⁵⁰ Oct	384 180 120	255	5495	60 Oct	24 230 410	680
57	60 Sep	386 040 38	360	5495	70 Jan	554 170 10	16
57	60 Oct	1429 105 56	370	Motrola	15 Aug	786 290 10	095
57	60 Jan	735 225	...	1740	15 Sep	974 270 5	030
57	65 Jan	424 085 10	860	1740	15 Oct	22 320 3996	060
				1740	1750 Aug	6117 080 731	030
				1740	1750 Sep	588 115 321	110

Source: From *The Wall Street Journal*, August 16, 2001, p. B6. Copyright © 2001 Dow Jones. Reprinted by permission of Copyright Clearance Center.

This is called leverage by option investors. Let's look at what happens when the price of the underlying stock rises before the option expires. Suppose an investor purchases the above-mentioned September 65 call option for \$2.30 per share and Microsoft's stock rises to \$70 by the option expiration date, an increase of 10.8 percent. The shareholder's return would be the same as this increase, 10.8 percent. But the call option's intrinsic value on the expiration date will be \$5—namely, \$70 less the exercise price of \$65. The investment of \$2.30 per share grew to a value of \$5 per share, a percentage return of $(\$5 - \$2.30)/\$2.30 = 117$ percent, far above the stockholder's percentage return.

What if Microsoft's stock price fell 10 percent, so by the expiration date the call option is out of the money? The shareholder faces a 10 percent loss on her investment. But the option holder faces a 100 percent loss; his option expires out of the money, worthless.⁴ The option's leverage is clear: Because a relatively small premium controls much value, small percentage changes in the value of the stock can result in large percentage changes for an option position. For this reason, option trading is not for the novice investor. However option trading strategies do exist that help reduce an investor's risk; we will discuss these later in the chapter.

Exhibit 11.11 is a sample of *The Wall Street Journal's* index option quotations. If, for example, an investor had done the last trade of the day on the September 600 call on the S&P 100 (calls are designated with a "c," puts with a "p"), the price would have been 18.50, which is a premium of \$1,850.00 per contract. The information in the column "Ranges for Underlying Indexes" shows that the underlying index closed at 603.02, which means that this option is in the money and has an intrinsic value of 3.02.

Exhibit 11.12 presents the sample quotations for currency options from *The Wall Street Journal*. Foreign currency options are traded on the Philadelphia Stock Exchange. Contracts trade on the Australian dollar, Canadian dollar, Euro, Japanese yen, and Swiss franc. Note both European and American versions of these options; the European options are labeled as "European Style." The American versions are more actively traded because they provide more flexibility.

Option Payoff Diagrams

Forwards and futures carry an *obligation* to execute the contract (unless offset by another contract so the investor's net position is zero). An option contract gives the owner the *option* to purchase (call option) or sell (put option) an asset. Thus, if exercising the option will cause the owner to lose wealth, the option can expire unexercised and have a value of zero. Whereas losses on futures and forwards can grow as a result of adverse moves in the value of the underlying asset, losses on option contracts can be truncated by merely choosing not to exercise them. In this case, the pre-tax loss is limited to the premium paid to purchase the option plus commission. Prudent use of options assist investors in managing risk.

At expiration, the intrinsic value of a call option will be either the asset's value minus the exercise price (if the asset's value exceeds the exercise price) or zero (if the asset's value is less than the strike price). If we let V denote the market value of the underlying asset and X denote the option's exercise price, the value of an option just prior to expiration will be the maximum of $V - X$ or 0; this can be written $\text{Max}[0, V - X]$. Panel A in Exhibit 11.13 graphically illustrates the payoff diagram for a call option with an exercise price of \$50. The value of the call option is zero should the asset value fall below \$50. If the asset's value rises above the exercise price, say to \$60,

⁴We ignore commissions and taxes for simplicity in this example.

EXHIBIT 11.11 Derivations for Options on Selected Indexes

Wednesday, August 15, 2001
 Volume, last, net change and open interest for all contracts. Volume figures are unofficial. Open interest reflects previous trading day, p-Put c Call

RANGES FOR UNDERLYING INDEXES

Wednesday, August 15, 2001

CHICAGO

DJ INDUS AVG(DJX)

STRIKE	VOL.	LAST	NET CHG.	OPEN INT.
Sep 90 p	5	096	+ 005	
Dec 90 p	10	096	+ 005	
Sep 92 p	313	092	- 005	
Dec 92 p	1	140		
Dec 94 p	5	165	+ 010	
Sep 95 p	99	096	+ 015	
Sep 95 c	1,105	180		
Mar 96 p	2	290		
Dec 97 p	64	210	+ 020	
Aug 98 c	50	640	+ 030	200
Sep 98 p	50	060	- 015	
Aug 100 c	4	370	+ 030	275
Aug 100 p	150	095		
Sep 100 c	7	450	+ 030	1,636
Sep 100 p	89	096	+ 005	
Dec 100 p	150	210	+ 010	
Aug 101 p	395	010		
Aug 102 c	93	105	- 040	8,715
Aug 102 p	706	015	- 020	
Sep 102 c	33	330	+ 010	8,378
Sep 102 p	201	175	+ 010	
Aug 103 c	76	095	- 005	1,221
Aug 103 p	358	040		
Aug 104 c	6,366	040	- 040	12,249
Aug 104 p	11,812	095	+ 030	
Sep 104 c	11,046	210	+ 040	6,229
Sep 104 p	3,557	290	+ 015	
Dec 104 c	1	520	+ 020	4,920
Dec 104 p	32	450	+ 020	
Mar 104 c	10	640	+ 060	2,034
Mar 104 p	160	590	+ 020	
Aug 105 c	55	030	- 030	1,121
Aug 105 p	55	140	+ 030	
Aug 106 c	360	095	- 005	16,739
Aug 106 p	114	270	+ 050	
Sep 106 c	33	150	+ 020	17,333
Sep 106 p	385	380	+ 060	
Aug 107 p	2	290	- 050	
Aug 108 p	8	410	+ 080	
Sep 108 c	255	090	- 005	7,337
Sep 108 p	1,906	450	+ 020	
Dec 108 c	362	290	+ 020	2,967
Dec 108 p	1,911	640	+ 020	
Mar 108 c	1	640	+ 060	3,756
Mar 108 p	10	780	+ 060	
Sep 110 c	65	030	- 005	8,430
Sep 110 p	3	610	+ 020	
Dec 110 c	10	220	- 015	11,402
Dec 110 p	3	730	+ 010	
Aug 112 p	2	640	- 130	
Sep 112 c	300	020	- 020	5,748
Dec 112 c	11	125	- 020	3,926
Mar 112 p	5	940	+ 070	
Dec 114 c	17	110	+ 005	1,683
Call Vol.	19,715	Open Int.	219,668	
Put Vol.	26,123	Open Int.	287,846	

	High	Low	Close	Net Chg	From 12/31	% Chg
DJ Indus (DJX)	104.70	103.41	103.46	- 0.66	- 4.41	- 4.1
DJ Trans (DIX)	286.53	283.07	283.37	- 2.55	- 11.29	- 3.8
DJ Util (DUX)	343.15	335.31	339.60	- 3.64	- 72.56	- 17.6
S&P 100 (OEX)	609.40	602.50	603.02	- 4.00	- 83.43	- 12.2
S&P 500 -A.M.(SPX)	1191.21	1177.61	1178.02	- 8.71	- 142.26	- 10.8
CB-Tech (TXN)	556.37	539.86	540.11	- 14.59	- 143.01	- 20.9
CB-Mexico (MEX)	79.28	77.78	77.78	- 1.36	- 9.47	- 10.9
CB-Lps Max (VEX)	7.93	7.78	7.78	- 0.13	- 0.94	- 10.8
MS MultiInd (NFT)	704.20	697.09	697.67	- 3.88	- 76.52	- 9.9
GSTC Comp (GTC)	210.83	203.96	203.98	- 5.84	- 79.59	- 28.1
Nasdaq 100 (NDX)	1641.84	1571.92	1572.03	- 57.92	- 769.67	- 32.9
NYSE (NYA)	609.85	604.78	605.90	- 1.64	- 50.97	- 7.8
Russell 2000 (RUT)	481.19	476.50	478.95	- 1.24	- 4.58	- 0.9
Lps S&P 100 (OEX)	121.88	120.50	120.60	- 0.80	- 16.69	- 12.2
Lps S&P 500 (SPX)	119.12	117.76	117.80	- 0.87	- 14.23	- 10.8
Volatility (VIX)	24.01	23.05	23.77	+ 0.76	+ 6.46	+ 21.4
S&P Midcap (MID)	605.48	499.61	502.75	- 1.19	- 14.01	- 2.7
Major Mkt (XMI)	1056.61	1047.07	1047.33	- 2.16	- 30.23	- 2.8
Eurotop 100 (EUR)	295.32	292.68	293.17	- 2.35	- 60.08	- 17.0
HK Flg (HKO)	234.77	234.77	234.77	+ 2.77	+ 60.75	+ 20.6
Int Internet (IX)	156.91	149.91	149.94	- 6.64	- 129.66	- 46.4
AM-Mexico (MXY)	107.47	105.41	105.41	- 1.48	+ 14.48	+ 15.9
Institut'l -A.M.(XII)	640.90	633.67	633.73	- 4.79	- 102.58	- 13.9
Japan (JPN)			125.01	- 1.70	- 19.41	- 13.4
MS Cyclical (CYC)	559.73	554.17	554.63	- 2.15	+ 43.45	+ 8.5
MS Consumr (CMR)	553.41	549.55	551.93	+ 2.38	+ 61.98	+ 10.1
MS Hi Tech (MST)	522.75	506.00	506.08	- 13.57	- 162.14	- 24.3
MS Internet (MOX)	14.39	13.67	13.68	- 0.61	- 15.11	- 52.5
Pharma (DRG)	401.84	396.75	397.43	- 0.70	- 49.95	- 11.2
Biotech (BTK)	519.82	502.60	503.05	- 13.63	- 131.27	- 20.7
Gold/Silver (XAU)	56.79	55.68	56.67	+ 0.79	+ 5.26	+ 10.2
Utility (UTY)	344.16	337.33	340.32	- 2.11	- 52.94	- 13.5
Value Line (VLE)	1214.84	1201.29	1204.67	- 7.46	+ 79.90	+ 7.1
Bank (BKC)	909.54	900.24	903.15	- 1.93	+ 1.73	+ 0.2
Semicond (SOX)	600.63	572.70	572.92	- 21.08	- 3.69	- 0.6
Street.com (DOT)	193.82	183.73	183.91	- 9.90	- 116.72	- 38.8
Oil Service (OSX)	89.32	83.51	89.04	+ 6.08	+ 35.74	+ 28.6
PSE Tech (PSE)	676.93	657.47	657.62	- 15.66	- 156.81	- 19.3

STRIKE	VOL.	LAST	NET CHG.	OPEN INT.
Oct 610 p	4	2290	+ 280	
Aug 610 c	51	175	- 295	
Aug 610 p	2	7	+ 110	2,144
Sep 610 p	20	17	+ 2	319
Oct 610 p	2	2050	- 050	3,850
Oct 615 c	2,167	060	- 165	3,855
Aug 615 p	901	13	+ 350	
Sep 615 p	1	1980	- 290	
Aug 620 c	4,298	090	- 070	6,009
Aug 620 p	581	1810	+ 510	
Sep 620 c	509	850	- 2	694
Sep 620 p	35	25	+ 320	
Oct 620 c	5	14	- 3	109
Oct 620 p	42	28		
Nov 620 p	50	36	+ 1	
Aug 625 c	451	055	+ 140	
Sep 625 c	1	2130	+ 510	201
Aug 625 p	2,459	015	- 030	3,219
Aug 625 p	1,509	23	+ 5	
Sep 625 c	116	690	- 160	20
Sep 625 p	17	27	+ 3	
Aug 630 c	2,267	065	- 100	6,576
Sep 630 p	28	5	- 6	
Sep 630 c	370	530	- 130	3,221
Sep 630 p	8	30	+ 4	
Aug 635 c	3,580	065	- 065	6,192
Aug 640 c	1,253	095	- 060	4,752
Aug 640 p	29	3740	+ 940	
Sep 640 c	112	360	- 030	2,493
Sep 640 p	30	3980	+ 440	
Oct 640 c	41	750	- 1	617
Aug 645 c	165	065	- 050	4,115
Aug 650 c	10	095	- 050	5,890
Aug 650 p	10	4760	+ 760	
Sep 650 c	121	185	- 035	1,118
Sep 650 p	11	45	+ 4	40
Oct 650 c	40	150	- 040	361
Aug 660 c	40	060	- 040	3,319
Sep 660 c	57	165	- 060	2,678
Sep 660 p	23	57	+ 7	
Oct 660 c	61	295	- 145	289
Sep 670 p	20	5780	+ 890	
Sep 670 c	21	045	- 035	1,134
Sep 680 c	21	030	- 015	2,354
Sep 680 p	20	010	- 030	866
Sep 700 p	66	9170	+ 260	
Call Vol.	27,140	Open Int.	112,226	
Put Vol.	25,913	Open Int.	103,285	

DJ UTIL AVG(DUX)

STRIKE	VOL.	LAST	NET CHG.	OPEN INT.
Dec 360 p	1	3040	+ 490	
Call Vol.	0	Open Int.	60	
Put Vol.	1	Open Int.	0	

STRIKE	VOL.	LAST	NET CHG.	OPEN INT.
Sep 1550 c	31	100		
Sep 1550 p	96	54	+ 6	1,738
Oct 1550 c	1	140		
Aug 1600 c	572	13	- 4430	455
Aug 1600 p	388	3320	+ 1990	1,375
Sep 1600 c	256	75	- 37	451
Sep 1800 p	455	90	+ 20	1,963
Aug 1650 c	425	180	- 1720	617
Aug 1650 p	323	65	+ 33	1,427
Sep 1650 c	6	55	- 33	658
Sep 1650 p	11	118	+ 25	1,877
Aug 1700 c	413	060	- 690	618
Aug 1700 p	236	133	+ 83	1,378
Sep 1700 c	22	3950	- 2540	2,108
Sep 1700 p	10	145	+ 39	1,801
Aug 1750 c	52	025	- 110	651
Aug 1750 p	11	17720	+ 4320	125
Sep 1750 c	21	25	- 2110	987
Aug 1800 c	30	015	- 035	3,018
Aug 1800 p	2	189	+ 54	372
Sep 1800 c	30	1630	- 1970	1,551
Sep 1800 p	150	220	+ 40	1,394
Oct 1800 p	1	220		
Sep 1850 c	6	15	- 1050	584
Sep 1850 p	57	650	- 650	1,683
Oct 1900 c	26	24	- 2770	1,351
Aug 1950 c	40	005	- 050	2,653
Sep 1950 c	431	450	- 550	790
Oct 1950 c	6	18	- 12	
Aug 2000 p	20	419	- 4960	27
Sep 2050 c	2	180	- 310	1,510
Sep 2100 c	253	1	- 150	444
Sep 2150 c	1	105	- 125	47
Sep 2200 c	20	070	- 030	636
Oct 2250 c	4	350	- 060	7
Sep 2300 c	4	080	- 060	554
Aug 2400 p	108	810	+ 143	114

S & P 500(SPX)

STRIKE	VOL.	LAST	NET CHG.	OPEN INT.
Sep 800 p	10	025	+ 005	8,475
Sep 800 c	20	050	+ 010	23,882
Aug 950 c	13	230	- 24	13
Aug 950 p	10	005	- 005	8,875
Sep 975 p	750	110	- 010	3,118
Sep 995 c	7	190		
Sep 995 p	150	590	- 060	1,564
Aug 1025 c	3,020	010	- 020	7,685
Sep 1025 c	22	160		
Sep 1025 p	96	215	+ 035	2,976
Oct 1025 p	1,525	590	+ 110	4,175
Aug 1050 p	620	005	- 005	9,688
Sep 1050 p	1,406	350	+ 010	24,327
Aug 1075 p	90	010	- 010	9,870
Sep 1075 c	1	112	+ 480	530
Sep 1075 p	232	5	+ 090	11,401
Oct 1075 p	33	9	+ 160	1,275
Aug 1100 p	377	020	+ 005	22,359
Sep 1102 p	203	750	+ 140	23,590
Oct 1100 p	10	14	+ 110	2,316
Aug 1125 p	1,272	90	- 170	1,265
Sep 1125 p	554	1040	+ 140	10,440
Oct 1125 p	20	18	- 200	2,688
Sep 1130 c	7	66		
Sep 1130 p	40	1150		
Aug 1150 c	290	2950	- 2110	1,402
Aug 1150 p	3,712	130	+ 010	16,186
Sep 1150 c	357	4950	- 650	3,020
Sep 1160 p	14,194	15	+ 2	25,311
Sep 1160 p	356	2450	+ 2	2,583
Sep 1160 p	25	1870	+ 140	411
Sep 1170 c	40	3660	- 1540	256
Sep 1170 p	100	2150	+ 2	336
Aug 1175 c	1,483	980	- 910</	

the intrinsic value of the call option rises dollar for dollar. In this case, the call option is valuable; the holder can buy a stock at \$50 when it has a current market value of \$60.

If this were not the case, arbitrage operations would make it so. For example, suppose the exercise price on a stock's call option is \$50 and the stock is selling for \$60. The call option has an intrinsic value of $V - X = \$60 - \$50 = \$10$. If the call option's price were only \$8, arbitrageurs would buy the option for \$8, immediately exercise it, and pay \$50 to purchase the stock; they would then sell the stock at its market price of \$60 and receive a profit of \$2, ignoring commissions and taxes. In other words, they pay a total of \$8 (option) plus \$50 (exercise price) or \$58; selling the stock for \$60 results in a \$2 profit. The buying pressure in the options market and selling pressure in the stock market would cause the option and stock prices or both to change and eliminate the risk-free profit opportunity.

Panel B of Exhibit 11.13 shows the payoff diagram for the seller or writer of the call option. Whereas increases in the asset's value above X are beneficial to the call purchaser, they harm the call seller. This is so because the call option allows the buyer to purchase the higher-priced asset at the lower exercise price. As the asset's value climbs, the call writer faces a larger loss. If the option is exercised and the call writer does not own the underlying asset, she may have to purchase the asset at price V and sell it to the call buyer at price X , suffering the loss $(X - V)$. For example, if the exercise price is \$50 and the stock's price rises to \$60, the call writer may have to purchase the stock in the open market at \$60 and sell it to the owner of the call option for \$50, thus losing \$10. If the call writer already owns the stock, she suffers an opportunity loss of \$10; instead of selling the stock at its spot price of \$60, she must sell it to the option holder at the exercise price of \$50.

Panels C and D in Exhibit 11.13 show payoff diagrams for put option buyers and writers. As the put option allows the owner to sell the underlying asset at the exercise price X , the put option becomes more valuable to the buyer as the value V of the asset falls below X . On the other hand, the option to sell an asset for X when the asset's value is greater than X will cause the put option to have no intrinsic value. Thus, the intrinsic value of the option at expiration is the maximum of $X - V$ or 0, or $\text{Max}[0, X - V]$. As the asset's value falls below the exercise price X , the option becomes more in the money and the value of the put option rises in correspondence with the fall of the asset's value, as seen in panel C.

For example, if a put option has an exercise price of \$50, the option is worthless if the stock's current market value is \$60; anyone wanting to sell the stock will choose to do so in the stock market and will receive \$60. If the stock's price is only \$40, however, the put option has an intrinsic value of $50 - 40 = \$10$ because it allows the owner of the put option to sell the stock for \$50 when the stock's market value is only \$40. Similar to the call option, arbitrage will ensure that this put option's price will be at least \$10. For example, should the put's price be \$7, arbitrageurs will buy the put for \$7 and buy the stock for \$40; they will then immediately exercise the put, forcing the put writer to purchase their stock at the exercise price of \$50. The arbitrageurs will gain a risk-free profit of \$3: \$7 (put option) + \$40 (stock's market value) or \$47; selling the stock by exercising the put gains them \$50, for a profit of $50 - 47 = \$3$.

The situation is reversed for the writer or seller of the put option. The payoff diagram for the writer of the put appears in panel D of Exhibit 11.13. As the asset's value falls below X , the writer will be forced to purchase the asset for more than the asset's current market value and suffer a loss of $V - X$. For example, if the put's exercise price is \$50 and the stock's market value is \$40, the put writer may have to purchase the stock at the \$50 exercise price, thereby paying \$10 more than the stock is currently

worth. Should the asset's value rise above X , the put option loses its intrinsic value because the asset can be sold in the open market for a price exceeding the put's exercise price.

Exhibit 11.14 summarizes some intrinsic values for these put and call relationships.⁵

Thus far, we have reviewed the intrinsic value of options to provide the basic concepts. In reality, the option's market value will equal its intrinsic value only at expiration; at all other times, the option's market price will exceed its intrinsic value. The major reason for this differential between intrinsic value and market price is *time*. As long as the option has time remaining until expiration, the option buyer is purchasing both the option's intrinsic *and* its time value. The remaining time to expiration on the option is important: The longer the time to expiration, the greater the chance of the option becoming in the money (if it was originally at the money or out of the money) or even more in the money than it originally was. Several factors affect the current market price of an option, including the option's exercise price, its time to expiration, the underlying asset's current price and price volatility, and the current market interest rate. We will discuss each of these factors in more detail in the next chapter.

OPTION TRADING STRATEGIES

Investors quickly learned that option trading greatly increases the number and complexity of investment strategies. We will not attempt to cover all the strategies, but will limit our discussion to the major alternatives. Also, we will begin with the basic techniques because the more advanced methods build on these. Some of the end-of-chapter

EXHIBIT 11.14 | Call and Put Intrinsic Values

Assume: Exercise price of \$50

Call Option			
Current Stock Price	Exercise Price	Intrinsic Value	Comment
(V)	(X)	$\text{Max } [0, V - X]$	
\$45	\$50	\$0	Out of the money
50	50	0	At the money
55	50	5	In the money

Put Option			
Current Stock Price	Exercise Price	Intrinsic Value	Comment
(V)	(X)	$\text{Max } [0, X - V]$	
\$45	\$50	\$5	In the money
50	50	0	At the money
55	50	0	Out of the money

⁵From the diagrams in panels B and D of Exhibit 11.13, some may wonder why anyone would sell a call or put option since the intrinsic value payoff diagrams show values that are either zero or negative. There are two responses to this observation. First, Exhibit 11.13 shows the intrinsic value of the option at expiration; it ignores other influences affecting the investor's position. For example, writers of put and call options receive the option premium. Thus, if the option expires out of the money, its intrinsic value is zero but the writer gains a profit (ignoring the effects of taxes and commissions) equal to the option premium received. Second, as we shall examine in a subsequent section, option writers frequently own the underlying security. The combined payoff profile from owning a security and writing options will look markedly different from those in panels B and D of the exhibit. The next section on Option Trading Strategies will show the combined payoff profiles.

references describe the more sophisticated techniques. In this section we explicitly take option premiums into consideration as we consider profits and losses from various option positions.

For the option trading strategies we shall examine, let's assume that the following options are available for trading.

Exercise Price (per share)	Call Premium (per share)	Put Premium
70	6.13	2.25
75	3.50	4.75

We will assume the stock price is \$73.25, and, for simplicity, we will ignore taxes and commissions and treat the options as European options. In addition, we will assume all strategies are held to expiration. Although this is not required and usually is not done, we cannot understand how to evaluate trading strategies closed out before expiration without a better grasp of option-pricing theory.

Buying Call Options

Investors buy call options because they expect the price of the underlying stock to increase during the period prior to the expiration of the option. If this expectation comes true, the purchase of an option will yield a large return on a small dollar investment.

Consider the purchase of the call option with a \$70 exercise price (we will refer to this as the 70 call). You would pay $100 \times \$6.13$ or \$613.00 for this call. The overall profit from the call option transaction can be stated as



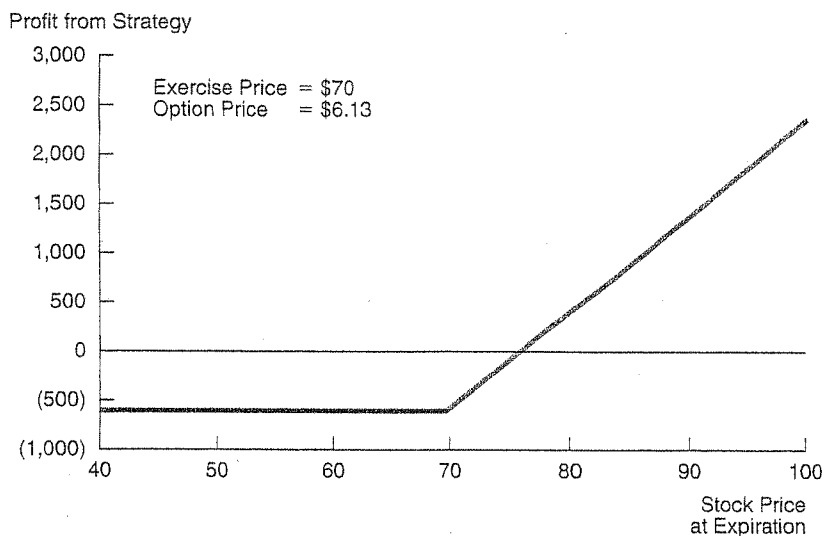
$$\text{Max } [0, V - X] - \text{Call Premium}$$

Assume the stock price ends up at \$68. The profit is $\text{Max } [0, 68 - 70] - 6.13 = -6.13$, or a loss of \$6.13 per option. If the stock price ends up at \$75, the profit is $\text{Max } [0, 75 - 70] - 6.13 = -1.13$, or a loss of \$1.13 per option. You would break even if the stock price at expiration is \$70 (the exercise price) + \$6.13 (the call premium), or \$76.13.

Exhibit 11.15 illustrates these results in the form of a payoff diagram that reflects the initial cost of the option premium. You can see that the call-buying strategy has a limited loss of the option premium, which in this case is \$613.00 per contract. No limit exists on the upside because the stock price can rise without limit. The leverage inherent in options is quite tempting. For example, assume the stock price rises 20 percent over the life of the option, going from \$73.25 to \$87.90. At expiration, the option would be worth \$17.90 ($\text{Max } [0, 87.90 - 70]$), or \$1,790 per 100-share contract. Thus, a 20 percent stock price increase would lead to a 192 percent increase in the option premium $[(17.90 - 6.13)/6.13]$. On the other hand, if the stock price fell from \$73.25 to \$65.00 by expiration, which is an 11.3 percent decline, the option value would fall to 0, a 100 percent loss. Although the loss is 100 percent of the option value, the dollar loss of \$6.13 a share is fairly small relative to the stock price (about 8.4 percent). Investors need to be careful about interpreting potential option profits and losses. The lure of potentially large profits with limited dollar losses must be tempered with the fact that the large profits occur quite rarely, whereas small losses occur quite frequently.

Suppose you had chosen the out-of-the-money option with the \$75 exercise price and paid a call premium of only \$3.50. This option would have limited your overall loss to \$350. However, the stock price would have had to rise to \$78.50 (\$75 exercise price + \$3.50 call premium) at expiration before you would have made money.

EXHIBIT 11.15 Profit for Buyer of Call Option



Buying call options can be part of a prudent tax strategy for some investors. For example, suppose a portfolio manager owns stock that has fallen in value but the manager still likes the stock's longer-term prospects. Here's the strategy: Toward the end of the calendar year (usually toward the end of November), the portfolio manager can buy a call option that expires sometime in the next year, say January. Thirty-one days⁶ after buying the call but before the end of the tax year the manager can sell the stock, thereby generating a capital loss that can be used to offset any capital gains and reduce taxes. Before the option expires in January, the manager can exercise it and reestablish a position in the stock at the low exercise price.

Selling Call Options

Now let's look at the profits for the individual who sold, or wrote, the 70 call. When a call is sold, the writer receives the premium, which in this case is \$6.13 (or, more properly, $\$6.13 \times 100$ shares or \$613.00). If we assume the seller does not own the stock, this transaction is referred to as an uncovered or naked call option, for reasons that will become apparent.

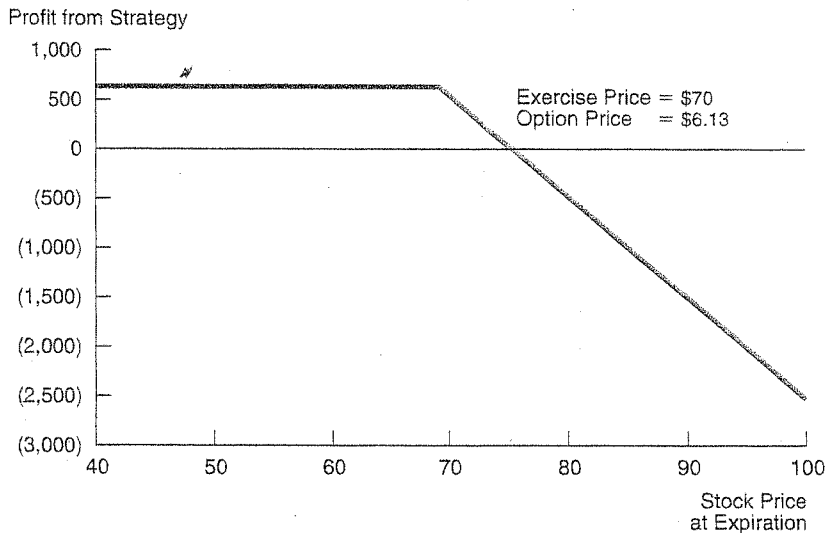
Recall that the seller of the call will *owe* the value $\text{Max}[0, V - X]$ at expiration because the seller may have to buy the stock at its market price, V , and sell it at X . If the stock price is substantially greater than the exercise price, the seller of the option can incur a large loss. As we saw above, the seller's profits are simply -1 times the buyer's profits.

Exhibit 11.16 is a graph of the seller's profits, which you should recognize as simply Exhibit 11.15 inverted. The seller of the option can earn a maximum amount equal

⁶Any buying and selling of similar securities is called a *wash sale*, and the U.S. tax code disallows any tax advantage—such as capital losses offsetting other capital gains—from a wash sale. This is why the investor cannot sell the shares at a depressed price and immediately repurchase them. But the use of the call option helps to preserve the currently depressed price of the stock until the option expires, allowing the investor to avoid the wash sale problem.

EXHIBIT 11.16

Profit from Strategy



to the premium of \$613.00, which is retained if the option ends up out of the money. The seller's loss is potentially unlimited.⁷

The risk of unlimited losses explains why we refer to this option writing strategy as uncovered or naked. If, however, the writer owns the stock, this is a covered call option. In this case, if the call option is exercised, the covered call writer need not buy the stock in the market. He or she simply delivers the stock held, effectively selling it for the exercise price. Thus out-of-pocket losses are minimal, aside from an opportunity cost if the option expires in the money (the writer of the call option sells the stock at a price below current market value).

The profit to the call writer from a covered call can be broken down into two components: the profit from writing the call and the profit on the stock held. The profit from writing the call is

$$\text{Call Premium}$$

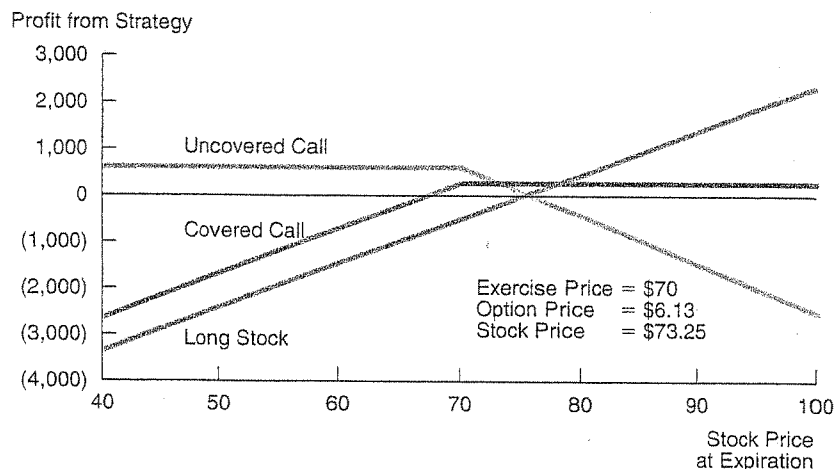
$$- \text{Max} [0, V - X] + \text{Call Premium}$$

The profit on the stock is either the current value V minus the original price the investor paid for the stock if the call expires out of the money, or the exercise price minus the original stock purchase price if the call expires in the money.

Exhibit 11.17 shows the profits of the writer of the covered call; graphically as well as arithmetically it equals the combined profits of its component strategies, the long position in the stock plus an uncovered call. If the stock falls, the covered call writer keeps the premium and the stock, while the premium received cushions against the loss in value of the stock. On the upside, however, the covered call writer's gains are limited because the stock must be sold for the exercise price regardless of how much it is worth in the market.

⁷Clearly, the seller can be "wiped out." For that reason, the seller's broker will generally require the seller to post margin money. Another way to reduce the risk of disaster is for the seller to own the stock, a strategy we shall examine next.

EXHIBIT 11-17 Profit from Selling a Call Option



Covered call writers are considered to be smart option traders because they make money by capitalizing on the public's excessive optimism about potential stock price moves. If the public is indeed overly optimistic, a covered call writer can collect the premiums, knowing that the stock is unlikely to move high enough to justify the premium. Many covered call writers view this as an opportunity to generate income from a slow-moving stock.

Buying Put Options

Several major reasons exist for acquiring a put option on a stock. The most obvious is that an investor expects a particular stock to decline in price and wants to profit from this decline. As we will show, buying a put option allows this with the benefits of leverage while limiting the potential loss if the expectation regarding a price decline in the stock is wrong. Buying put options offers two advantages over selling the stock short: (1) the losses are limited to the put premium and (2) costly short-sale margin requirements are avoided. In addition, put options can serve as a hedge if you own a stock and do not want to sell it at the present time, although you believe it might decline in the near term. In this case, you can buy a put option on the stock you own as a hedge against the decline; if the stock does decline, you will offset the decline with an increase in the value of the put option.

Consider the strategy of purchasing the 70 put for \$2.25. The put will be worth $\text{Max}[0, X - V]$ at expiration. Thus, the profit from buying the put can be expressed as

$$\text{Max}[0, X - V] - \text{Put Option Premium}$$

If the put expires in the money, the put owner can effectively buy the stock in the market for V and sell it to the put writer for the higher exercise price X . The profit on the transaction is this trading profit minus the put premium paid up front. If the put expires out of the money, the put's intrinsic value is zero (no trading profit) and the put holder simply loses the put premium that was paid up front.

Suppose the stock price ends up at \$60. The \$60 stock can be sold for \$70, netting a profit of $\$10 - \$2.25 = \$7.75$ per share, or \$775 per contract. If the stock price ends

up at \$80, the option expires worthless and the put holder loses the \$225 premium. Exhibit 11.18, which illustrates the profits for the put buyer, shows that the put buyer's loss is limited to the premium of \$225. The gains are limited because the stock price can never fall below zero. If the company went bankrupt, the stock could theoretically fall to zero and the put buyer would make $\$70 - \$2.25 = \$67.75$ per option or \$6,775 overall. Of course, this extreme case is quite unlikely.

Puts, like calls, also offer enormous leverage. Assume again that the stock is currently priced at \$73.25. If the stock price falls 20 percent to \$58.60, the put price will rise 406.7 percent to \$11.40. Because the put is currently out of the money (\$73.25 exceeds the exercise price of \$70), should the price fall 4.44 percent to \$70, the put option will expire worthless and its loss will be 100 percent.

One of the more attractive strategies employing puts is called the protective put. This involves the purchase of a put accompanied by a long position in the stock. Should the price of the stock decline below the exercise price, the rising value of the put option will offset the decline in the stock price. Similar to the covered call, the profit from this strategy can be broken down into the profit from the stock plus the profit from the put option.

Exhibit 11.19 graphically illustrates the returns on a protective put by combining the payoff diagrams for a stock purchase with those of a long put position. Notice that the protective put payoff diagram resembles that of the long call in Exhibit 11.15. In fact, it is sometimes referred to as a synthetic call because the holder of the protective put has limited losses and unlimited gains. Thus, two different option trading strategies result in similar payoffs regardless of the stock's price at expiration. We will return to this interesting point in our discussion of put/call parity later in this chapter.

The protective put is also a classic example of how to insure (hedge) a stock position. The holder of the stock can be viewed as someone holding an asset at risk of losing value. Some investors might be interested in purchasing insurance that would limit the losses on the asset. The put serves as this insurance. By paying the premium up front, the insurer (the put writer) promises to absorb all stock price decreases below the

EXHIBIT 11.18 Profits to Buyer of Put Option

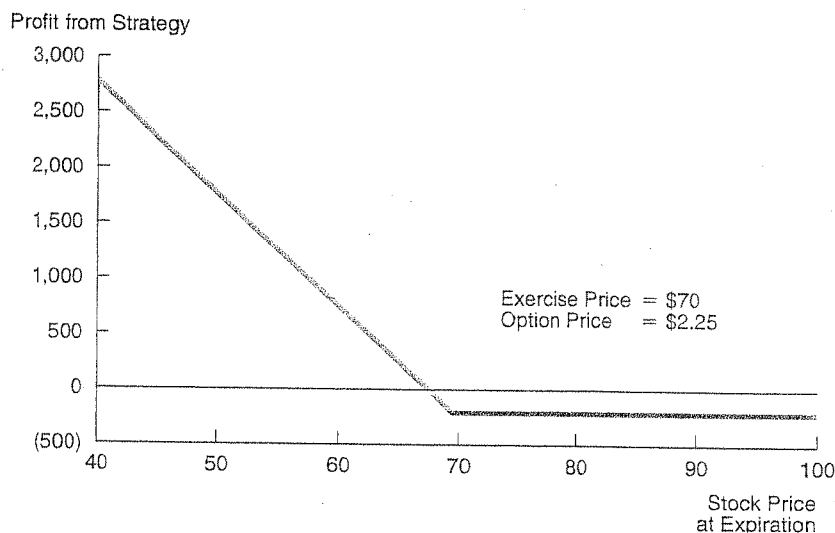
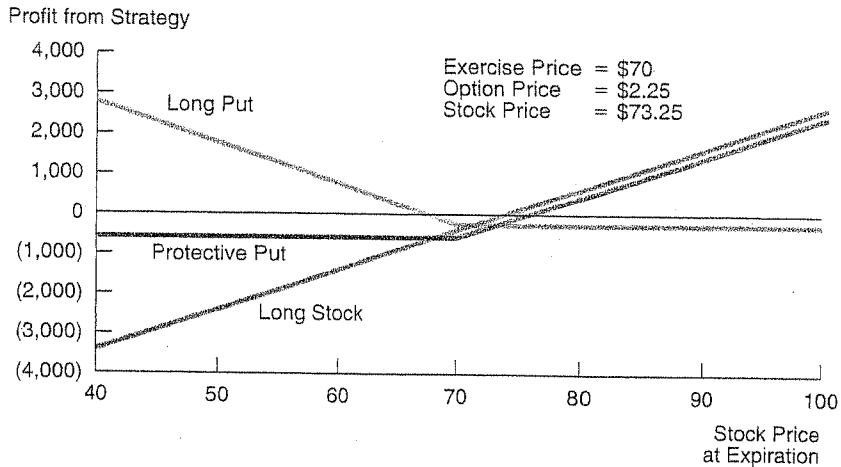


EXHIBIT 11.18 Profit from Protective Put Strategy



exercise price. If the stock price rises, the put expires worthless, which is equivalent to an insurance policy expiring without having had a claim.

Selling Put Options

The seller or writer of the put option, like the seller of the call option, has a profit that can be expressed as simply -1 times the put option buyer's profit. The seller of the put is accepting the premium up front for his willingness to purchase the stock at expiration at the exercise price. The put seller's gains are limited. His losses (like the put buyer's gains), although limited, can be quite large if the stock price experiences a dramatic decline.

Exhibit 11.20 illustrates the profits to the seller of the put option. Comparing Exhibit 11.20 with Exhibit 11.18, we can see that these two exhibits are mirror images of each other.

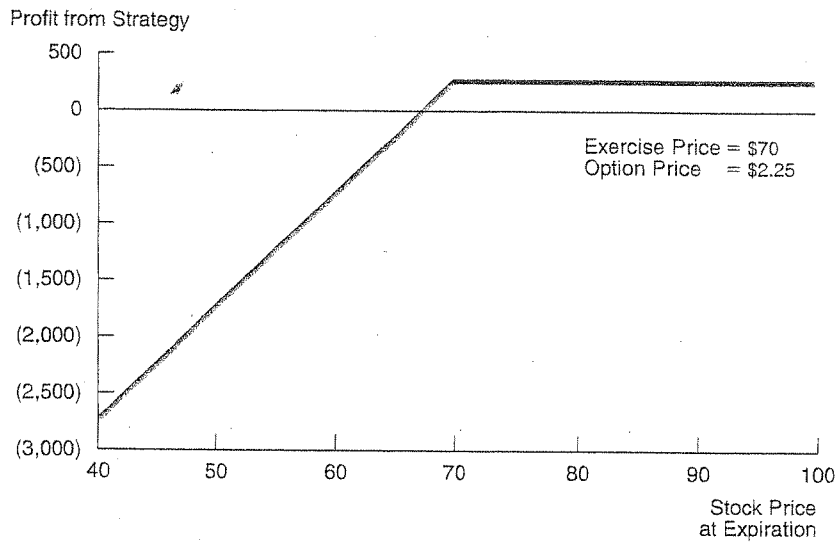
Option Spreads

Rather than simply buying or selling a call option, an investor can do both by entering into a spread. There are two basic types of spreads. First, a price spread (also called a *vertical spread*) involves buying the call option for a given stock, expiration date, and strike price, and selling the call option for the same stock and expiration date but at a different strike price (for example, buying a Ford October 20 and selling a Ford October 30). The second type, a time spread (also called a *horizontal* or *calendar spread*), involves both buying and selling options for the same stock and strike price but with different expiration dates (for example, buying a Ford October 30 and selling a Ford January 30). Option spreads can serve a variety of investment goals.

Bullish Spreads. You might consider a bullish spread strategy if you were generally bullish (optimistic) on the underlying stock but you wanted to be conservative. Assume you are optimistic on the outlook for Ford stock, which is currently selling for \$22, and want to enter into a price spread. Assume also that a Ford October 20 option is currently priced at 7, whereas a Ford October 30 option is priced at 2.

Because you are bullish you would buy the higher-priced Ford October 20 option and sell the lower-priced Ford October 30 option. The net cost of 5 (\$500) is your

EXHIBIT 11.20 Profits to Seller of Put Option



maximum loss. If your expectations are correct and the stock rises from \$22 to \$35, the October 20 option will be worth about 15, its intrinsic value, whereas the October 30 will sell for about 5. Closing out both positions would give you a \$500 gain, as follows:

October 20: Bought at 7, Sold at 15	= Gain 8
October 30: Sold at 2, Bought at 5	= Loss 3
Overall	= Gain 5

If the stock were to decline dramatically, your maximum loss would be \$500 (your initial cost), even though both options would expire worthless. Your maximum gain would also be \$500. At some high stock price, the value of the options will differ by 10, which would give you a gross profit of \$1,000 less the \$500 initial cost. The payoff diagram for this option trading strategy is shown in Exhibit 11.21.

Bearish Spreads. Assume, on the other hand, that you are generally bearish (pessimistic) on a stock or the market and want to act using a conservative strategy. You could enter into a bearish spread, selling the higher-priced option and buying the lower-priced option. You would sell the Ford October 20 at 7, and buy the Ford October 30 at 2, generating an immediate gain of \$500.

If you are correct and Ford stock declines below 20, both options will expire worthless and you will have the \$500 profit. In contrast, if the stock rises to 35, the results would be as follows:

October 20: Sold at 7, Bought at 15	= Loss 8
October 30: Bought at 2, Sold at 5	= Gain 3
Overall	= Loss 5

The loss of \$500 compares favorably with the potential loss of \$800 or more if the spread had not partially offset the adverse movement. At a high stock price, the two options will differ in price by 10, so your maximum loss is \$500, or a gross loss of \$1,000 less a \$500 gain on the original transaction. This payoff diagram is shown in Exhibit 11.22.

EXHIBIT 11.21 Payoff Diagram for a Bullish Price Spread

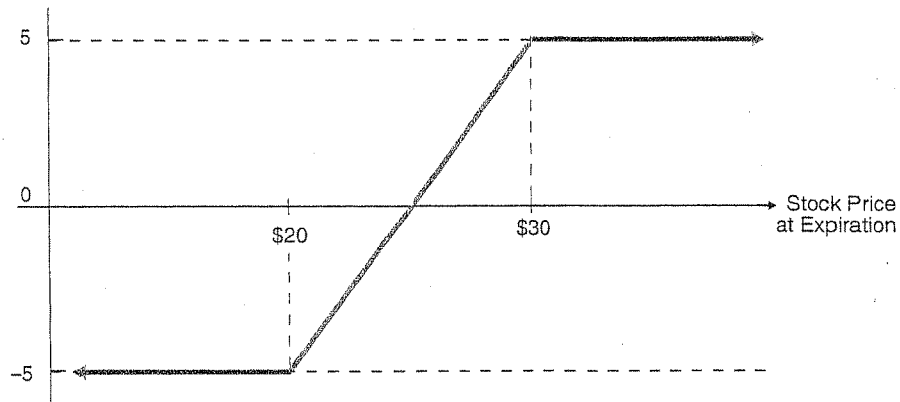
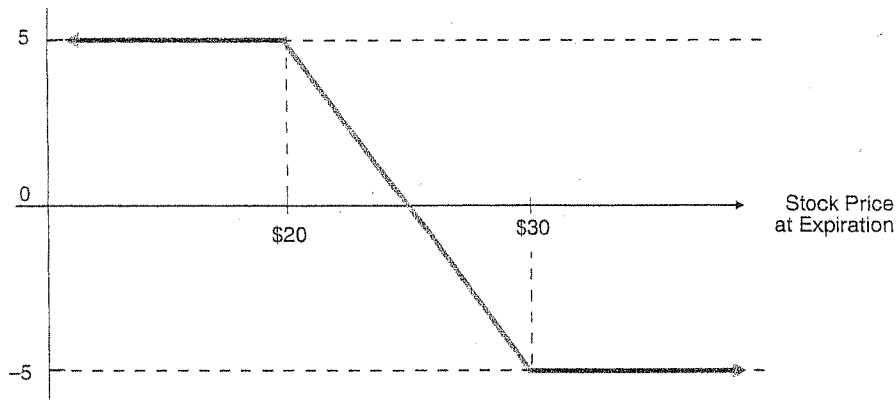


EXHIBIT 11.22 Payoff Diagram for a Bearish Price Spread



Option spreads allow numerous other potential transactions to meet almost any possible set of risk–return conditions. Ever inventive, option traders have labeled certain strategies as *straddles*, *strangles*, and *butterfly spreads*.

Straddle. A straddle is a combination of a call and a put with the same expiration date and the same exercise price, which will be close to the underlying security's current value. Buying a straddle (buying the call and the put) is used when an investor expects a large price move in the underlying security but is not sure whether the price will rise or fall. A short straddle position (writing a call and writing a put) is entered when an investor believes the underlying security's price will not be very volatile. Exhibit 11.23 shows the straddle payoff diagrams.

Strangle. A strangle is similar to a straddle. A strangle is a combination of a call and put with the same expiration date but with *different* exercise prices. The investor will purchase out-of-the-money calls and puts—that is, a call with an exercise price above

that of the underlying security's current price and a put with an exercise price below the underlying security's current price. The motivation for entering a strangle position is similar to that of a straddle, although the range over which the underlying security's price can vary before the position gains a profit (long strangle) or loss (short strangle) is larger than that of the straddle. Exhibit 11.24 presents the strangle payoff diagrams.

Butterfly Spread. The risk of a straddle or strangle position is the loss if the underlying security's price stays within a narrow range (long straddle or strangle) or varies widely (short straddle or strangle). A butterfly position reduces the risk exposure, as well as the potential profitability, of these trading strategies. A long butterfly spread would entail buying a call with a low exercise price, buying a call with a high exercise price, and selling two calls with an exercise price in between the two. Thus, it is a position involving three separate call contracts (with low, moderate, and high exercise prices). A short butterfly spread involves the opposite positions, namely selling or writing call options with a low and a high exercise price and buying two calls with a moderate exercise price. Exhibit 11.25 illustrates the butterfly payoff diagrams.

Expected Return and Risk. A review of the payoff diagrams will show differing levels of possible returns and risks with different option trading strategies. Least risky (in terms of potential variability in return) are the butterfly spreads, bullish price spreads, and bearish price spreads. Strategies that provide downside protection with potential for participating in favorable underlying security price moves include buying a call, buying a put, a long straddle, and a long strangle. Income-generating strategies include

EXHIBIT 11.23 Payoff Diagrams for Long and Short Straddle Positions

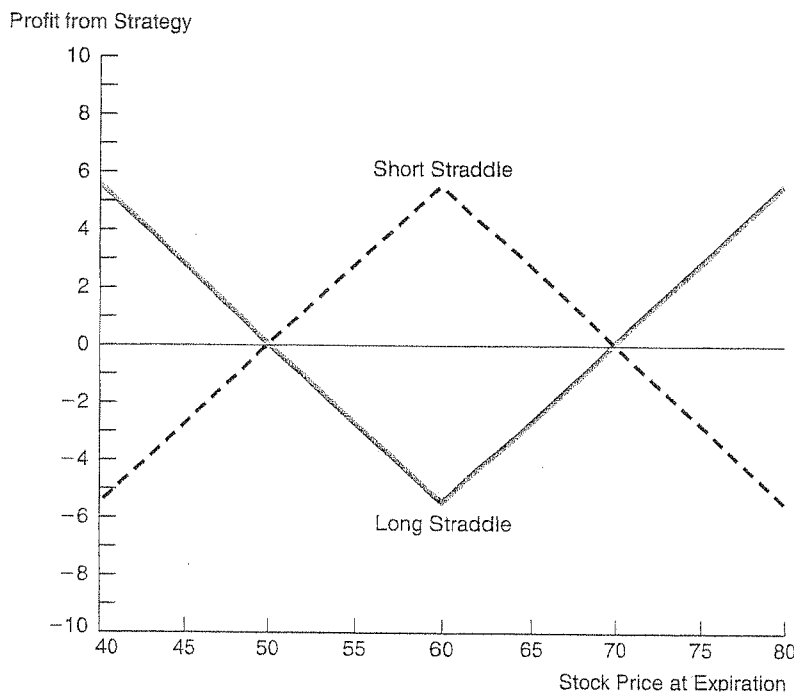


EXHIBIT 11.24 | Payoff Diagrams for Long and Short Strangle Positions

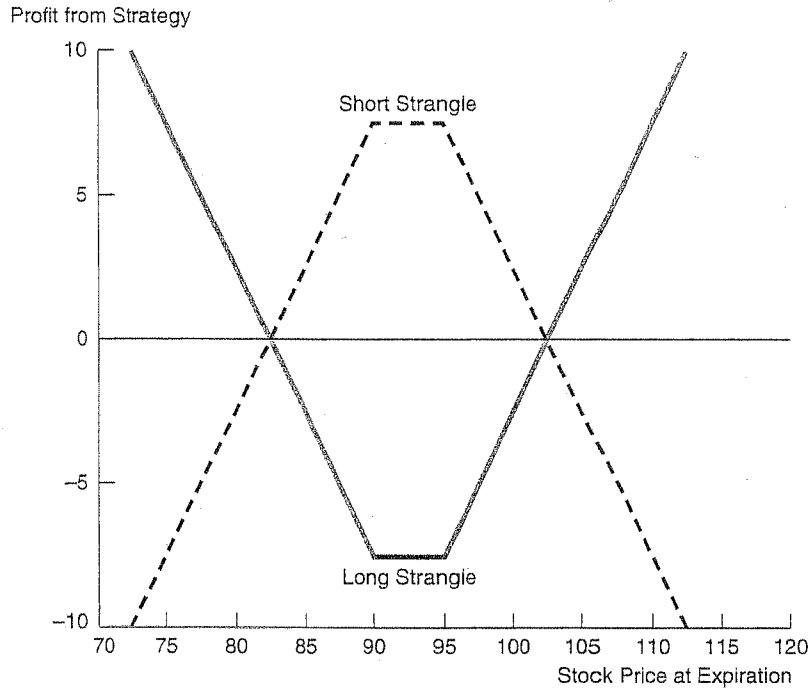
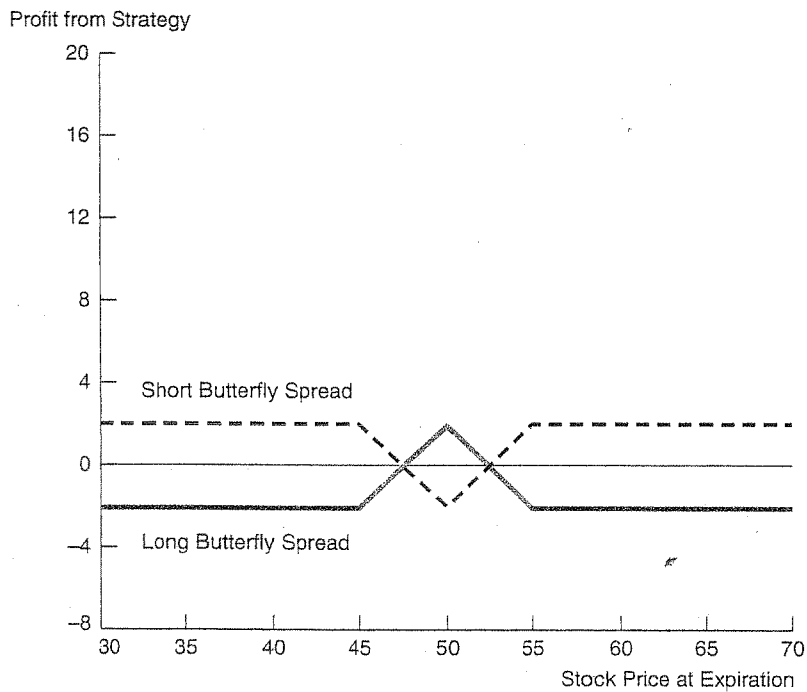


EXHIBIT 11.25 | Payoff Diagrams for Long and Short Butterfly Spread Positions



writing calls, writing puts, and covered call strategies, but each of these has the potential for large losses if the underlying security price moves against the position. The riskiest strategies, in terms of loss potential, are the short straddle, short strangle, and writing uncovered calls and puts. Which strategy should be used depends on the purpose of the position (for example, to hedge, generate extra income, or take advantage of an expected price move in the underlying security), the investor's expectations about future price direction and volatility, and the investor's preferences, including, of course, risk preferences.

PUT/CALL PARITY

As it turns out, the prices of calls and puts are not completely independent of one another. They are related to each other through a concept known as put/call parity. The basic intuition behind this concept is that if two portfolios will have the same value at some future time T , the prices of the two portfolios should be the same today. Arbitrage will result if this is not true because investors will buy the underpriced portfolio and sell the overpriced one until their prices are equivalent.

Consider four securities: one call and one put option (each with the same exercise price of \$50, on one share of the same stock), one share of the stock, and one risk-free zero-coupon bond with par value of \$50. The two options and the bond mature or expire on the same day, T . Suppose we construct portfolio A consisting of the share of stock and the put option. Suppose we also construct portfolio B consisting of the call option and the risk-free discount bond with a par value of \$50.

We know the values of the options depend on the stock's value, V , at expiration and the option's exercise price, X . Let's examine these two portfolios under two situations: first with the stock's price V less than the exercise price X (\$50) at expiration; and then with V exceeding X (\$50) at expiration. These results are shown in Exhibit 11.26.

In the first case, V (say, \$40) is less than or equal to X (\$50), so the call option expires worthless, out of the money. The value of portfolio B is 0 (value of call option) + \$50 (par value of the matured bond), which sums to \$50. For portfolio A, the put option expires in the money and will have a value equal to $X - V$; the stock itself has

EXHIBIT 11.26 Valuation of Portfolios A and B on the Option Expiration Date, Time T

	Value at Expiration, Time T			
	Stock Price < Exercise Price		Stock Price > Exercise Price	
Portfolio A				
One share of stock	V		V	
One put option	$X - V$		0	
	X		V	
Portfolio B				
One call option	0		$V - X$	
Risk-free discount bond	X		X	
	X		V	

a price of V . The value of portfolio A at option expiration is $\$50 - \40 (value of the put option) + $\$40$ (value of the stock), which sums to $\$50$. Thus, if the stock's price is less than $\$50$ when the options expire, the values of portfolios A and B both equal $\$50$.

In the second case, V (say, $\$60$) is greater than X ($\50), so the call option expires in the money, with a value of $\$60 - \$50 = \$10$. The value of portfolio B will then be $\$60 - \50 (value of call option) + $\$50$ (par value of matured bond), which sums to $\$60$. The put option expires out of the money and so has a value equal to 0. The stock itself has a price of V . The value of portfolio A at option expiration is 0 (value of the put option) + $\$60$ (value of the stock), which sums to $\$60$. Thus, if the stock's price is greater than $\$50$ when the options expire, the values of portfolios A and B both equal $\$60$.

So we see that portfolios A and B will have the same value when the options expire under each possibility. If the stock's price is less than the exercise price, both portfolios have a value of X , or $\$50$; if the stock's price is greater than the exercise price, both portfolios will have a value of V , or $\$60$ in this example. Because they both have the same value at time T , both portfolios must have the same price today. Thus, the value of portfolio A must equal the value of portfolio B:

$$\begin{aligned} \text{11.4} \quad & \text{Stock Price} + \text{Put Premium} \\ & = \text{Call Premium} + \text{Risk-Free Discount Bond Price} \end{aligned}$$

This result is not really all that surprising. Recall that earlier we saw that the payoff diagrams of Exhibit 11.19 (protective put) and Exhibit 11.15 (call option) are identical. That is what the relationship in equation 11.4 expresses algebraically. The left-hand side of the equation is the protective put strategy: long on the stock and long on a put option. The right-hand side represents a long call position, with the extra cash invested in a risk-free security (the extra cash represents the difference between the stock's price and the call premium). Arbitrage will ensure that the value of a protective put strategy will be in parity with that of a long call position.

By rearranging equation 11.4 in numerous ways, we can determine the appropriate price of a put option as a function of the call price, stock price, and the price of risk-free discount bonds:

$$\text{11.5} \quad \text{Put Premium} = \text{Call Premium} + \text{Risk-Free Discount Bond} - \text{Stock Price}$$

Sketching a payoff diagram of a combination of a long call and a short stock position will show a payoff resembling that of a long put position; buying a call and shorting the stock is a synthetic put. Similarly, we can determine the call's price from the values of the other three assets. We can also estimate the stock's price using information about the prices of call and put options and risk-free discount bonds:

$$\text{11.6} \quad \text{Stock Price} = \text{Call Premium} - \text{Put Premium} + \text{Risk-Free Discount Bond}$$

This shows that the payoff diagram for a long stock position results from combining the payoffs of a long call and short put position.⁴

Futures prices are also related to call and put option prices. To see this intuitively, recall that the payoff diagram for a long futures position is identical to that of a long position in the underlying asset. The same applies to a short futures position and its underlying asset. We will examine futures valuation in Chapter 12.



Investments Online

A good way to learn more about the basics of futures and options is to visit some derivative-related Web sites. Interesting futures and options exchange sites include:

www.cboe.com The Web site of the Chicago Board Options Exchange presents an overview of the exchange and options on equities, indexes, and LEAPS and FLEX options. Market data, including quotes, are available. The site offers educational materials for beginners and discussions of investment strategies. By inputting some data, users can compute the theoretical value of an option using the site's options calculator.

www.cbot.com The home page of the Chicago Board of Trade, the world's largest futures exchange, includes an overview of the board, a dictionary of trading jargon, as well as price quotes and charts. The site offers government agriculture reports (many commodities are traded on the CBOT) and weather reports (weather affects commodity yields).

www.cme.com The Chicago Mercantile Exchange's Web site features information similar to that of the other exchanges: news, price quotes, information on products, and educational resources. The Merc's site offers Web-based lessons on derivative strategies and even offers an "Introduction to Hand Signals" used by floor traders.

www.liffe.com LIFFE stands for the London International Financial Futures and Options Exchange. It is Europe's premier derivatives exchange. The site includes information on money, market, bond, equity, index, and commodity trading.

www.options-iri.com (also found at www.schaeffersresearch.com) The Web site of the Investment Research Institute serves the investing public. It advertises option trading resources, but it also has several valuable (and free) educational resources. The site reviews option basics and option trading strategies (from simple to complex). It offers users a daily options-market commentary, a market forecast, and free option quotes. This site is useful for those who want to get a flavor for how traders and investors use options.

SUMMARY

- Derivative securities are rising in importance and popularity. Forwards, futures, and options are used in a variety of ways, both by investors and corporations. They can be used to control risk through hedging, to generate income through writing puts and calls, or to earn capital gains.
- Forward contracts are the oldest derivative; a forward contract represents an obligation by the owner to buy the underlying asset before a specified date (the expiration date) at a specified price (the exercise or strike price). The gain or loss on a forward contract is transmitted on the contract's expiration date. The value of a forward contract rises and falls with increases and decreases in the value of the underlying asset. Currencies are the underlying asset for many forward contracts.
- Futures contracts also represent an obligation by the owner to purchase the underlying asset on a specified day and at a specified price. Notably, the futures' liquidity is enhanced by standardized contracts. Credit risk is also reduced because buyers and sellers of futures must post a margin account. Through the process of marking to the market, the daily change in the value of an investor's position is added to or subtracted from the margin accounts. If the balance in the margin account becomes too low, a margin call will be issued.
- A major distinction between option and futures contracts is that the option contract provides the owner with the *right*, rather than an obligation, to buy an asset (call

options) or sell an asset (put options). This feature allows options buyers to limit their losses if the price of the underlying asset moves adversely to their position. Various trading strategies are available to options investors, including buying and selling calls and puts, writing covered calls, and using protective puts.

- Investors can use option trading strategies as an uncovered position or to hedge existing investment positions. Many expected return-risk possibilities exist among the different option trading strategies.
- Puts, calls, and the same underlying asset will have prices that are related to each other; this is called put/call parity. Arbitrage among the spot market, futures market, and options market will ensure that put/call parity holds rather closely over time.

Questions

1. How are options like forward contracts? How are they different?
2. How do forward contracts differ from futures contracts? How are they similar?
3. Identify the maximum and minimum prices of puts and calls and explain why they are the maximum and minimum.
4. If the price of a stock and a put option exceeded the price of a call option and a risk-free bond with a face value equal to the exercise price, what kind of transaction should you make? Explain.
5. What is a derivative security? Why would an investor want to own or sell a derivative instead of the underlying asset?
6. Why do futures contracts have less credit or default risk than forward contracts?
7. Discuss the ways a portfolio manager can use futures contracts.
8. Why are futures and option contracts available on only a limited set of assets?
9. For options written on the same stock and at the same exercise price, would the price of an American option be greater than, less than, or equal to the price of a European option? Explain.
10. Is it riskier to write covered or uncovered calls? Explain.
11. Compare and contrast the following options strategies: buy a call option, long straddle, long strangle, and long butterfly spread.
12. When might an investor use a bullish or bearish price spread rather than a butterfly spread?
13. How can buying call options help reduce the possible tax obligation from an investor's portfolio?
14. *CFA Examination Level II*

Current equity call prices for Furniture City are contained in the table below. In reviewing these prices Jim Smith, CFA, notices discrepancies between several option prices and basic option-pricing relationships.

Closing Prices, Furniture City Equity Call Options

May 30, 1998						
Expiration Month						
Close	Strike	June	July	August	September	
119 $\frac{1}{2}$	110	8 $\frac{7}{8}$	12 $\frac{1}{2}$	15 $\frac{1}{2}$	18 $\frac{1}{2}$	
119 $\frac{1}{2}$	120	1 $\frac{1}{2}$	3 $\frac{3}{4}$	3 $\frac{1}{2}$	4 $\frac{1}{4}$	
119 $\frac{1}{2}$	130	1	2 $\frac{1}{4}$	2 $\frac{7}{8}$	5 $\frac{1}{2}$	

Identify *three different* apparent pricing discrepancies in the table. Identify which of the basic option-pricing relationships *each* discrepancy violates.

[Note: The fact that option contracts do not always trade at the same time as the underlying stock should *not* be identified as a discrepancy.] (12 minutes)

15. *CFA Examination Level I*

Michelle Industries issued a Swiss franc-denominated five-year discount note for SFr200 million. The proceeds were converted to U.S. dollars to purchase capital equipment in the United States. The company wants to hedge this currency exposure and is considering the following alternatives:

- a. At-the-money Swiss franc call options
- b. Swiss franc forwards
- c. Swiss franc futures

Contrast the essential characteristics of *each* of these *three* derivative instruments. Evaluate the suitability of *each* in relation to Michelle's hedging objective, including both advantages and disadvantages. (15 minutes)

16. *CFA Examination Level II*

Linda Morgan is evaluating option strategies that will allow her to profit from large moves in a stock's price, either up or down. She believes that a combination of a long put and a long call option with the same expiration and exercise price (straddle) would meet her objective.

Price information on APEX stock and options is presented below.

APEX Stock and Option Current Market Prices

APEX stock: \$50

Call option with an exercise price of \$50 expiring December: \$4

Put option with an exercise price of \$50 expiring December: \$3

No transactions costs or taxes exist.

- a. Draw a net-profit-and-loss diagram at expiration for the straddle, using the above information. Calculate and label the following on a graph:
 - i. Maximum loss.
 - ii. The breakeven points of the position. (10 minutes)
- b. Morgan is considering a lower-cost strategy that would allow her to profit from large changes in the stock's price.

APEX Stock and Option Current Market Prices

APEX stock: \$50

Call option with an exercise price of \$55 expiring December: \$2.50

Put option with an exercise price of \$45 expiring December: \$2.00

No transactions costs or taxes exist.

Draw a net-profit-and-loss diagram at expiration for the alternative option strategy, using the above information. Calculate and label the following on a graph:

- i. Maximum loss.
- ii. The breakeven points of the position. (10 minutes)

Problems

1. The current stock price is 56. Find the lower bound of the option prices assuming the following exercise prices.
 - a. 55 call
 - b. 60 call
 - c. 55 put
 - d. 60 put
2. Find the value at expiration of the following options if the stock price at expiration is 41.
 - a. 40 call
 - b. 45 call
 - c. 40 put
 - d. 45 put

3. Using the information in Exhibit 11.2, how much more or less expensive is it to buy Swiss francs with a one-month forward contract rather than purchase francs in the spot market? In the three-month forward market? In the six-month forward market? Redo these calculations, this time using the Japanese yen.
4. Answer the following using the futures price data in Exhibit 11.5.
- What is the dollar value of the July 2003 corn futures contract at the settlement price?
 - Suppose the initial margin requirement is 5 percent of the contract value. How much must you deposit in a margin account on this contract if you purchase it at the settlement price?
 - Suppose the contract expires at a price of 275 cents per bushel. What is your percentage return?
5. Answer the following using the futures price data in Exhibit 11.5.
- The notation by the future price quotation for the S&P Midcap 400 Index states the value of the contract is \$500 times the index. Suppose the initial margin is 10 percent. How much must you deposit in the margin account if you buy the September contract at the settlement price?
 - Compare the return on your futures investment to the return on a cash investment in the index if the September contract expires at 540. The cash market value of the index is listed in the last line of the Midcap Index quotes.
 - Compare the return on your futures investment to the return on a cash investment in the index if the September contract expires at 490.
6. IBM's options listing appears in Exhibit 11.10.
- What was the closing price of IBM stock?
 - Which options are in the money? Out of the money?
 - What is the dollar return on the August 105 call option if you purchased it and the expiration date price of IBM stock is \$100? \$105? \$110?
 - What is the dollar return on the September 110 put option if you purchased it and the expiration date price of IBM stock is \$105? \$110? \$115?
7. Answer the following using the data for Microsoft's options appearing in Exhibit 11.10.
- What is the value of the time premium between the September and January 60 call options? Put options?
 - What is the intrinsic value of the October 65 call and put options? The January 70 call and put options?
 - What arbitrage would investors do if the September 55 call was priced at 7.25?
 - What arbitrage would investors do if the September 65 put was priced at 0.50?
8. Do the following using the data for Microsoft's options appearing in Exhibit 11.10.
- Draw the payoff diagram if an October 60 call is purchased.
 - Draw the payoff diagram for writing an uncovered call using the October 60 call option.
 - Draw the payoff diagram for writing a covered call using the October 60 call option.
9. Do the following using the data for Microsoft's options appearing in Exhibit 11.10.
- Draw the payoff diagram if a January 65 put is purchased.
 - Draw the payoff diagram for a protective put strategy using the January 65 put option.
 - Draw the payoff diagram for writing the January 65 put option.
10. Using the data from Exhibit 11.10, compute the following:
- The dollar return from a bullish spread of buying the IBM September 110 call and selling the September 115 call if the expiration price is \$95; \$105; \$115; \$125.
 - The dollar return from a bearish spread of buying the IBM September 115 call and selling the September 110 call if the expiration price is \$95; \$105; \$115; \$125.
11. Illustrate put/call parity in the case of stock options with an exercise price of \$100 (that is, replicate Exhibit 11.26 using appropriate numerical values).
12. Using the stock price, call premium, and put premium data for Intel's October 30 options (from Exhibit 11.10), use put/call parity to estimate the price of a risk-free discount bond.
13. Assume the appropriate risk-free discount bond has a par value of 34.24. Using the stock price and call premium for the Intel January 35 option (from Exhibit 11.10), what should be the premium for the January 35 put option?

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14. A put option on a stock has an exercise price of \$35 and is priced at \$2 a share. A call option with the same exercise price is priced at \$4. What is the maximum loss per share to a writer of an uncovered put and the maximum profit per share to a writer of an uncovered call?
- W
15. An investor buys 200 shares of stock for \$43 per share and sells call options for all this stock, with an exercise price of \$45, for a premium of \$3 per share. Ignoring dividends and transaction costs, what is the maximum profit the investor can earn if this position is held to expiration?
- W
16. An investor buys an ExxonMobil August 80 call for \$5.00 and an August 80 put for \$1.25.
- What is this option trading strategy called?
 - Determine the dollar payoff if the price of ExxonMobil at the expiration date is \$65; \$75; \$85; \$95.
17. An investor buys a McDonald's call option with a June expiration and an exercise price of \$40 at a premium of \$8; he also purchases a June 50 call option at a premium of \$2.50. In addition, he writes two June 45 McDonald's call options and collects the premium of \$3.75 for each.
- What is the name of this option trading strategy?
 - What is the dollar payoff if, at June expiration, the price of McDonald's stock is \$30? \$35? \$42.50? \$45? \$47.50? \$50? \$60?
18. An investor buys a Coca-Cola September 60 call for \$6.00 and a September 50 put for \$0.25.
- What is this option trading strategy called?
 - Determine the dollar payoff if the price of Coca-Cola at the expiration date is \$40; \$45; \$50; \$55; \$60; \$70.

Web Exercises

- Your supervisor at the financial institution where you work wants you to investigate the possibility of using mortgage futures to hedge some of its risk. Since mortgage futures are one of the variety of contracts traded on the CBOT, go to www.cbot.com and investigate mortgage futures. Specifically: what does the item "traded" mean when buying and selling mortgage futures? How is delivery made? What is the index underlying the mortgage futures contract, and how is it calculated?
- Explain the differences between the Chicago Board of Trade (www.cbot.com), Chicago Board Options Exchange (www.cboe.com), and the Chicago Mercantile Exchange (www.cme.com). What kinds of educational resources are offered through each organization for your further study?
- Two types of options traded on the CBOE are FLEX and LEAPS options. From information found on the CBOE Web site, write a paragraph explaining what each of these are.
- What new options and futures products have been recently introduced by the options and futures exchanges? How might the new contracts assist investors?
- Locate, from doing a Web search, firms that offer forward contracts in currencies and agricultural products.

Spreadsheet Exercises

- Develop a spreadsheet using logical operators to determine the intrinsic value of (a) a call option and (b) a put option.
- Develop a spreadsheet to determine, for different levels of stock prices, the intrinsic value of the following for both long and short option positions.
 - Bullish, bearish spread
 - Straddle
 - Strangle
 - Butterfly spread
- Develop a spreadsheet to estimate the returns (based on different final stock prices) of (a) owning stock; (b) owning call options; (c) owning stock plus put options (a protective put strategy). Using a stock purchase price of \$45, and an exercise price of \$50, estimate the



The Market for Foreign Exchange

Function and Structure of the FOREX Market

- FX Market Participants
- Correspondent Banking Relationships

The Spot Market

- Spot Rate Quotations
- The Bid-Ask Spread
- Spot FX Trading
- Cross-Exchange Rate Quotations
- Alternative Expressions for the Cross-Exchange Rate
- The Cross-Rate Trading Desk
- Triangular Arbitrage
- Spot Foreign Exchange Market Microstructure

The Forward Market

- Forward Rate Quotations
- Long and Short Forward Positions
- Forward Cross-Exchange Rates
- Swap Transactions
- Forward Premium
- Summary
- Key Words
- Questions
- Problems
- Internet Exercises

MINI CASE: Shrewsbury Herbal Products, Ltd.

References and Suggested Readings

www.bis.org.

This is the website of the Bank for International Settlements. Many interesting reports and statistics can be obtained here. The report titled *Triennial Central Bank Survey* can be downloaded for study.

MONEY REPRESENTS PURCHASING power. Possessing money from your country gives you the power to purchase goods and services produced (or assets held) by other residents of your country. But to purchase goods and services produced by the residents of another country generally first requires purchasing the other country's currency. This is done by selling one's own currency for the currency of the country with whose residents you desire to transact. More formally one's own currency has been used to buy *foreign exchange* and in so doing the buyer has converted his purchasing power into the purchasing power of the seller's country.

The market for foreign exchange is the largest financial market in the world by virtually any standard. It is open somewhere in the world 365 days a year, 24 hours a day. The 2001 triennial central bank survey compiled by the Bank for International Settlements (BIS) places worldwide daily trading of spot and forward foreign exchange at \$1.2 trillion dollars per day. This is equivalent to nearly \$200 in transactions for every person on earth. This, however, represents a 19 percent decrease over 1998. The decline is due to the introduction of the common euro currency, which eliminates the need to trade one euro zone currency for another to conduct business transactions, and to consolidation within the banking industry. London remains the world's largest foreign exchange trading center. According to the 2001 triennial survey, daily trading volume in the U.K. is estimated at \$504 billion, a 21 percent decrease from 1998. U.S. daily turnover was \$254 billion, which represents a 28 percent decline from 1998. Exhibit 4.1 presents a pie chart showing the shares of global foreign exchange turnover.

Broadly defined, the **foreign exchange (FX or FOREX) market** encompasses the conversion of purchasing power from one currency into another, bank deposits of foreign cur-

rency, the extension of credit denominated in a foreign currency, foreign trade financing, trading in foreign currency options and futures contracts, and currency swaps. Obviously, one chapter cannot adequately cover all these topics. Consequently, we confine the discussion in this chapter to the spot and forward market for foreign exchange. In Chapter 9, we examine currency futures and options contracts, and in Chapter 10, currency swaps are discussed.

This chapter begins with an overview of the function and structure of the foreign exchange market and the major market participants that trade currencies in this market. Following is a discussion of the spot market for foreign exchange. This section covers how to read spot market quotations, derives cross-rate quotations, and develops the concept of triangular arbitrage as a means of ensuring market efficiency. The chapter concludes with a discussion of the forward market for foreign exchange. Forward market quotations are presented, the purpose of the market is discussed, and the purpose swap rate quotations is explained.