CHAPTER 1

Introduction

Derivatives markets have become increasingly important in the world of finance and investments. It is now essential for all finance professionals to understand how these markets work, how they can be used, and what determines prices in them. This book addresses these issues.

Derivatives are traded on exchanges and in what are termed "over-the-counter" (OTC) markets. The two main products trading on exchanges are futures and options. In the over-the counter markets forwards, swaps, options, and a wide range of other derivatives transactions are agreed to. Prior to the crisis which started in 2007, the OTC derivatives market was relatively free from regulation. This has now changed. As we will explain, OTC market participants are now subject to rules requiring that trades be reported, that collateral be provided, and that trading platforms be used.

This opening chapter starts by providing an introduction to futures markets and futures exchanges. It then compares exchange-traded derivatives markets with OTC derivatives markets and discusses forward contracts, which are the OTC counterpart of futures contracts. After that, it introduces options and outlines the activities of hedgers, speculators, and arbitrageurs in derivatives markets.

1.1 FUTURES CONTRACTS

A *futures contract* is an agreement to buy or sell an asset at a certain time in the future for a certain price. There are many exchanges throughout the world trading futures contracts. These include the CME Group (www.cmegroup.com), the Intercontinental Exchange (ICE; www.intercontinentalexchange.com), Euronext (www.euronext.com), Eurex (www.eurexchange.com), BM&FBOVESPA (www.bmfbovespa.com.br), the National Stock Exchange of India (www.nse-india.com), the Tokyo Financial Exchange (www.tfx.co.jp), and the China Financial Futures Exchange (www.cffex.com.cn). A table at the end of this book gives a more complete list.

Futures exchanges allow people who want to buy or sell assets in the future to trade with each other. In June, a trader in New York might contact a broker with instructions to buy 5,000 bushels of corn for September delivery. The broker would immediately communicate the client's instructions to the CME Group. At about the same time,

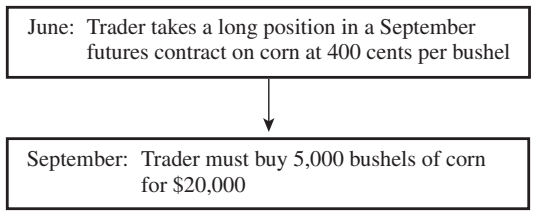

Figure 1.1 A futures contract (assuming it is held to maturity)

another trader in Kansas might instruct a broker to sell 5,000 bushels of corn for September delivery. These instructions would also be passed on to the CME Group. A price would be determined and the deal would be done.

The trader in New York who agreed to buy has what is termed a *long futures position*; the trader in Kansas who agreed to sell has what is termed a *short futures position*. The price is known as the *futures price*. We will suppose the price is 400 cents per bushel. This price, like any other price, is determined by the laws of supply and demand. If at a particular time more people wish to sell September corn than to buy September corn, the price goes down. New buyers will then enter the market so that a balance between buyers and sellers is maintained. If more people wish to buy September corn than to sell September corn, the price goes up—for similar reasons.

Issues such as margin requirements, daily settlement procedures, trading practices, commissions, bid–offer spreads, and the role of the exchange clearing house will be discussed in Chapter 2. For the time being, we can assume that the end result of the events just described is that the trader in New York has agreed to buy 5,000 bushels of corn for 400 cents per bushel in September and the trader in Kansas has agreed to sell 5,000 bushels of corn for 400 cents per bushel in September. Both sides have entered into a binding contract. The contract is illustrated in Figure 1.1.

A futures price can be contrasted with the *spot price*. The spot price is for immediate, or almost immediate, delivery. The futures price is the price for delivery at some time in the future. The two are not usually equal. As we will see in later chapters, the futures price may be greater than or less than the spot price.

1.2 HISTORY OF FUTURES MARKETS

Futures markets can be traced back to the Middle Ages. They were originally developed to meet the needs of farmers and merchants. Consider the position of a farmer in June of a certain year who will harvest a known amount of corn in September. There is uncertainty about the price the farmer will receive for the corn. In years of scarcity it might be possible to obtain relatively high prices, particularly if the farmer is not in a hurry to sell. On the other hand, in years of oversupply the corn might have to be disposed of at fire-sale prices. The farmer and the farmer's family are clearly exposed to a great deal of risk.

Consider next a company that has an ongoing requirement for corn. The company is also exposed to price risk. In some years an oversupply situation may create favorable prices; in other years scarcity may cause the prices to be exorbitant. It can make sense for the farmer and the company to get together in June (or even earlier) and agree on a

price for the farmer's estimated production of corn in September. This involves them negotiating a type of futures contract. The contract provides a way for each side to eliminate the risk it faces because of the uncertain future price of corn.

We might ask what happens to the company's requirements for corn during the rest of the year. Once the harvest season is over, the corn must be stored until the next season. If the farmer stores the corn, the company and the farmer both face risks associated with the future corn price, and again there is a clear role for futures contracts.

The Chicago Board of Trade

The Chicago Board of Trade (CBOT) was established in 1848 to bring farmers and merchants together. Initially, its main task was to standardize the quantities and qualities of the grains that were traded. Within a few years, the first futures-type contract was developed. It was known as a *to-arrive contract*. Speculators soon became interested in the contract and found trading the contract to be an attractive alternative to trading the grain itself. The CBOT developed futures contracts on many different underlying assets, including corn, oats, soybeans, soybean meal, soybean oil, wheat, Treasury bonds, and Treasury notes. It became part of the CME Group in 2007.

The Chicago Mercantile Exchange

In 1874 the Chicago Produce Exchange was established, providing a market for butter, eggs, poultry, and other perishable agricultural products. In 1898 the butter and egg dealers withdrew from the exchange to form the Chicago Butter and Egg Board. In 1919, this was renamed the Chicago Mercantile Exchange (CME) and was reorganized for futures trading. Since then, the exchange has provided a futures market for many commodities, including pork bellies (1961), live cattle (1964), live hogs (1966), and feeder cattle (1971). In 1982 it introduced a futures contract on the Standard & Poor's (S&P) 500 Stock Index.

The Chicago Mercantile Exchange started futures trading in foreign currencies in 1972. The currency futures traded now include the euro, British pound, Canadian dollar, Japanese yen, Swiss franc, Australian dollar, Mexican peso, Brazilian real, South African rand, New Zealand dollar, Russian rouble, Chinese renminbi, Swedish krona, Czech koruna, Hungarian forint, Israeli shekel, Korean won, Polish złoty, and Turkish lira. The Chicago Mercantile Exchange developed the very popular Eurodollar futures contract. (As later chapters will explain, this is a contract on the future value of a short-term interest rate.) It has also introduced futures contracts on weather and real estate.

The CME Group now includes the Chicago Board of Trade, the New York Mercantile Exchange, and the Kansas City Board of Trade.

Electronic Trading

Traditionally futures have been traded using what is known as the *open-outcry system*. This involves traders physically meeting on the floor of the exchange, known as the "trading pit," and using a complicated set of hand signals to indicate the trades they would like to carry out. In the example we considered earlier, one floor trader would represent the person in New York who wanted to buy September corn and another floor trader would represent the person in Kansas who wanted to sell September corn.

Business Snapshot 1.1 The Lehman Bankruptcy

On September 15, 2008, Lehman Brothers filed for bankruptcy. This was the largest bankruptcy in US history and its ramifications were felt throughout derivatives markets. Almost until the end, it seemed as though there was a good chance that Lehman would survive. A number of companies (e.g., the Korean Development Bank, Barclays Bank in the UK, and Bank of America) expressed interest in buying it, but none of these was able to close a deal. Many people thought that Lehman was "too big to fail" and that the US government would have to bail it out if no purchaser could be found. This proved not to be the case.

How did this happen? It was a combination of high leverage, risky investments, and liquidity problems. Commercial banks that take deposits are subject to regulations on the amount of capital they must keep. Lehman was an investment bank and not subject to these regulations. By 2007, its leverage ratio had increased to 31:1, which means that a 3–4% decline in the value of its assets would wipe out its capital. Dick Fuld, Lehman's Chairman and Chief Executive, encouraged an aggressive deal-making, risk-taking culture. He is reported to have told his executives: "Every day is a battle. You have to kill the enemy." The Chief Risk Officer at Lehman was competent, but did not have much influence and was even removed from the executive committee in 2007. The risks taken by Lehman included large positions in the instruments created from subprime mortgages, which will be described in Chapter 8. Lehman funded much of its operations with short-term debt. When there was a loss of confidence in the company, lenders refused to roll over this funding, forcing it into bankruptcy.

Lehman was very active in the over-the-counter derivatives markets. It had over a million transactions outstanding with about 8,000 different counterparties. Lehman's counterparties were often required to post collateral and this collateral had in many cases been used by Lehman for various purposes. Litigation attempting to determine who owes what to whom has continued for many years after the bankruptcy filing.

Futures exchanges throughout the world have largely replaced the open outcry system by *electronic trading*, where traders enter their required trades at a keyboard and a computer is used to match buyers and sellers. Electronic trading has led to a growth in high-frequency and algorithmic trading, which involve the use of computer programs to initiate trades, often without human intervention.

1.3 THE OVER-THE-COUNTER MARKET

Futures contracts are very popular exchange-traded contracts. Options, which are introduced later in this chapter, also trade very actively on exchanges. But not all trading of derivatives is on exchanges. Many trades take place in the *over-the-counter* (OTC) market. Banks, other large financial institutions, fund managers, and corporations are the main participants in OTC derivatives markets. The number of derivatives transactions per year in OTC markets is smaller than in exchange-traded markets, but the average size of the transactions is much greater.

Business Snapshot 1.2 Systemic risk

Systemic risk is the risk that a default by one financial institution will create a "ripple effect" that leads to defaults by other financial institutions and threatens the stability of the financial system. There are huge numbers of over-the-counter transactions between banks. If Bank A fails, Bank B may take a huge loss on the transactions it has with Bank A. This in turn could lead to Bank B failing. Bank C that has many outstanding transactions with both Bank A and Bank B might then take a large loss and experience severe financial difficulties; and so on.

The financial system has survived defaults such as Drexel in 1990 and Lehman Brothers in 2008, but regulators continue to be concerned. During the market turmoil of 2007 and 2008, many large financial institutions were bailed out, rather than being allowed to fail, because governments were concerned about systemic risk.

When a nonfinancial company wants to trade a derivative in the OTC market, it usually contacts a derivatives dealer (typically a large bank). If an agreement is reached, the derivatives dealer may absorb the risks as part of its portfolio. Alternatively, it may choose to enter into an offsetting transaction with another derivatives dealer.

Prior to the credit crisis, which started in 2007 and is discussed in some detail in Chapter 8, OTC derivatives markets were largely unregulated. Following the credit crisis and the failure of Lehman Brothers (see Business Snapshot 1.1), we have seen the development of many new regulations affecting the operation of OTC markets. The main purpose of the regulations is to improve the transparency of OTC markets and reduce systemic risk (see Business Snapshot 1.2 for a discussion of systemic risk). The over-the-counter market in some respects is being forced to become more like the exchange-traded market. Three important changes are:

1. Standardized OTC derivatives between two financial institutions in the United States must whenever possible be traded on what are referred to as *swap execution facilities* (SEFs). These are platforms similar to exchanges where market participants can contact each other to agree on trades.
2. There is a requirement in most parts of the world that a central counterparty (CCP) be used for most standardized derivatives transactions between two financial institutions. The CCP's role is to stand between the two sides in an over-the-counter derivatives transaction in much the same way that an exchange does in the exchange-traded derivatives market. CCPs are discussed in more detail in Chapter 2.
3. All trades must be reported to a central repository.

Market Size

Both the over-the-counter and the exchange-traded market for derivatives are huge. Although the statistics that are collected for the two markets are not exactly comparable, it is clear that the over-the-counter market is much larger than the exchange-traded market. The Bank for International Settlements (www.bis.org) started collecting statistics on the markets in 1998. Figure 1.2 compares (a) the estimated total principal amounts underlying transactions that were outstanding in the over-the-counter markets

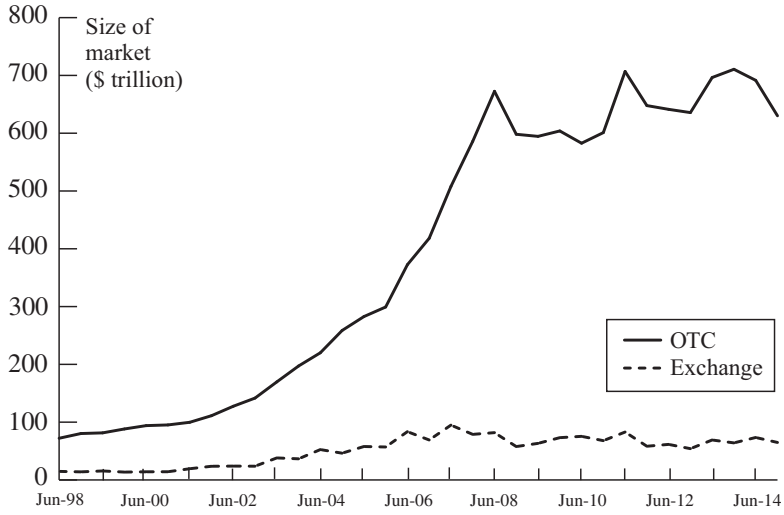

Figure 1.2 Size of over-the-counter and exchange-traded derivatives markets

between 1998 and 2014 and (b) the estimated total value of the assets underlying exchange-traded contracts during the same period. Using these measures, the size of the over-the-counter market was $630 trillion in December 2014 and that of the exchange-traded market was $65 trillion at this time. Figure 1.2 shows that the OTC market grew rapidly before the 2008 credit crisis and that there has been very little net growth since then.

In interpreting Figure 1.2, we should bear in mind that the principal underlying an over-the-counter transaction is not the same as its value. An example of an over-the-counter transaction is an agreement to buy 100 million U.S. dollars with British pounds at a predetermined exchange rate in one year. The total principal amount underlying this transaction is $100 million. However, the value of the transaction at a particular point in time might be only $1 million. The Bank for International Settlements estimates the gross market value of all OTC contracts outstanding in December 2014 to be about $21 trillion.[1]

1.4 FORWARD CONTRACTS

A forward contract is similar to a futures contracts in that it is an agreement to buy or sell an asset at a certain time in the future for a certain price. But, whereas futures contracts are traded on exchanges, forward contracts trade in the over-the-counter market.

Forward contracts on foreign exchange are very popular. Most large banks employ both spot and forward foreign exchange traders. Spot traders are trading a foreign currency for almost immediate delivery. Forward traders are trading for delivery at a future time. Table 1.1 provides quotes for the exchange rate between the British pound (GBP) and the U.S. dollar (USD) that might be made by a large international bank on

[1] A contract that is worth $1 million to one side and −$1 million to the other side would be counted as having a gross market value of $1 million.

Table 1.1 Spot and forward quotes for the USD/GBP exchange rate, May 13, 2015 (GBP = British pound; USD = U.S. dollar; quote is number of USD per GBP)

	Bid	*Offer*
Spot	1.5746	1.5750
1-month forward	1.5742	1.5747
3-month forward	1.5736	1.5742
6-month forward	1.5730	1.5736

May 13, 2015. The quote is for the number of USD per GBP. The first row indicates that the bank is prepared to buy GBP (also known as sterling) in the spot market (i.e., for virtually immediate delivery) at the rate of $1.5746 per GBP and sell sterling in the spot market at $1.5750 per GBP. The second row indicates that the bank is prepared to buy sterling in one month at $1.5742 per GBP and sell sterling in one month at $1.5747 per GBP; the third row indicates that it is prepared to buy sterling in three months at $1.5736 per GBP and sell sterling in three months at $1.5742 per GBP; and so on.

The quotes are for very large transactions. (As anyone who has traveled abroad knows, retail customers face much larger spreads between bid and offer quotes than those in Table 1.1.) After examining the quotes in Table 1.1, a large corporation might agree to sell £100 million in six months for $157.30 million to the bank as part of its hedging program.

There is a relationship between the forward price of a foreign currency, the spot price of the foreign currency, domestic interest rates, and foreign interest rates. This is explained in Chapter 5.

1.5 OPTIONS

Options are traded both on exchanges and in the over-the-counter markets. There are two types of option: calls and puts. A *call option* gives the holder the right to buy an asset by a certain date for a certain price. A *put option* gives the holder the right to sell an asset by a certain date for a certain price. The price in the contract is known as the *exercise price* or the *strike price*; the date in the contract is known as the *expiration date* or the *maturity date*. A *European option* can be exercised only on the maturity date; an *American option* can be exercised at any time during its life.

It should be emphasized that an option gives the holder the right to do something. The holder does not have to exercise this right. This fact distinguishes options from futures (or forward) contracts. The holder of a long futures contract is committed to buying an asset at a certain price at a certain time in the future. By contrast, the holder of a call option has a choice as to whether to buy the asset at a certain price at a certain time in the future. It costs nothing (except for margin requirements, which will be discussed in Chapter 2) to enter into a futures contract. By contrast, a trader must pay an up-front price, known as the *option premium*, for an option contract.

Table 1.2 Prices of call options on Google, May 13, 2015; stock price: bid $532.20; offer $532.34

Strike price ($)	*June 2015*		*Sept. 2015*		*Dec. 2015*	
	Bid	*Offer*	*Bid*	*Offer*	*Bid*	*Offer*
475	57.90	61.80	66.00	68.90	73.50	76.50
500	34.80	37.10	45.90	47.90	54.90	56.60
525	16.70	17.30	30.40	31.30	40.20	41.10
550	5.60	6.20	18.60	19.40	28.10	29.00
575	1.55	1.80	10.50	11.30	18.80	20.20

The largest exchange in the world for trading stock options is the Chicago Board Options Exchange (CBOE). Table 1.2 gives the bid and offer quotes for some of the call options trading on Google (ticker symbol: GOOG) on May 13, 2015. Table 1.3 does the same for put options trading on Google on that date. The tables have been constructed from data on the CBOE web site. The Google stock price at the time of the quotes was bid 532.20, offer 532.34. The bid–offer spread for an option, as a percentage of its price, is greater than that for the underlying stock and depends on the volume of trading. The option strike prices in the tables are $475, $500, $525, $550, and $575. The maturities are June 2015, September 2015, and December 2015. The June options have a maturity date of June 19, 2015; the September options have a maturity date of September 18, 2015; the December options have a maturity date of December 18, 2012. (The maturity date is the third Friday of the delivery month.)

The tables illustrate a number of properties of options. The price of a call option decreases as the strike price increases; the price of a put option increases as the strike price increases. Both types of options tend to become more valuable as their time to maturity increases. These properties of options will be discussed further in Chapter 10.

Suppose that a trader instructs a broker to buy one December call option contract on Google with a strike price of $550. The broker will relay these instructions to a trader at the CBOE and the deal will be done. The (offer) price is $29.00, as indicated in Table 1.2. This is the price for an option to buy one share. In the United States, an

Table 1.3 Prices of put options on Google, May 13, 2015; stock price: $532.20; offer $532.34

Strike price ($)	*June 2015*		*Sept. 2015*		*Dec. 2015*	
	Bid	*Offer*	*Bid*	*Offer*	*Bid*	*Offer*
475	0.95	1.05	5.50	9.20	12.50	15.20
500	2.95	3.30	13.00	13.80	21.30	22.10
525	9.40	9.90	22.40	23.20	31.30	32.00
550	22.90	24.40	35.20	36.40	44.10	45.00
575	42.70	45.80	51.90	53.50	59.70	61.00

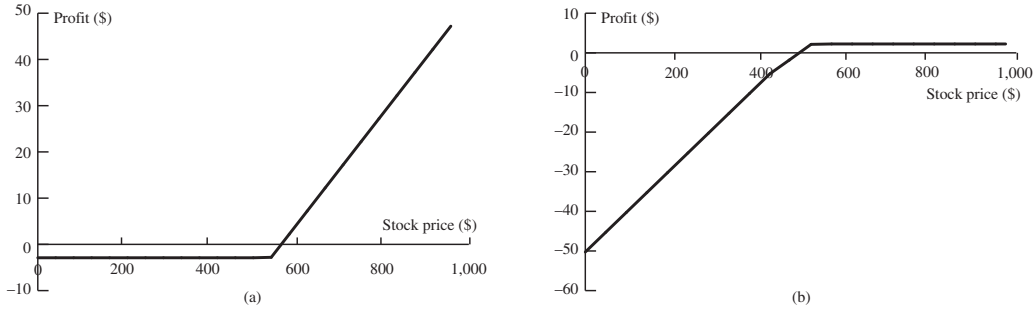

Figure 1.3 Net profit from (a) purchasing a contract consisting of 100 Google December call options with a strike price of \$550 and (b) selling a contract consisting of 100 Google September put options with a strike price of \$525

option contract is an agreement to buy or sell 100 shares. Therefore, the trader must arrange for \$2,900 to be remitted to the exchange through the broker. The exchange will then arrange for this amount to be passed on to the party on the other side of the transaction.

In our example, the trader has obtained at a cost of \$2,900 the right to buy 100 Google shares for \$550 each. If the price of Google does not not rise above \$550.00 by December 18, 2015, the option is not exercised and the trader loses \$2,900.[2] But if Google does well and the option is exercised when the bid price for the stock is \$650, the trader is able to buy 100 shares at \$550 and immediately sell them for \$650 for a profit of \$10,000—or \$7,100 when the initial cost of the options is taken into account.[3]

An alternative trade would be to sell one September put option contract with a strike price of \$525 at the bid price of \$22.40. This would lead to an immediate cash inflow of $100 \times 22.40 = \$2,240$. If the Google stock price stays above \$525, this option is not exercised and the trader makes a profit of this amount. However, if stock price falls and the option is exercised when the stock price is, say, \$480 there is a loss. The trader must buy 100 shares at \$525 when they are worth only \$480. This leads to a loss of \$4,500, or \$2,260 when the initial amount received for the option contract is taken into account.

The stock options trading on the CBOE are American (i.e., they can be exercised at any time). If we assume for simplicity that they are European, so that they can be exercised only at maturity, the trader's profit as a function of the final stock price for the two trades we have considered is shown in Figure 1.3.

Further details about the operation of options markets and how prices such as those in Tables 1.2 and 1.3 are determined by traders are given in later chapters. At this stage we note that there are four types of participants in options markets:

1. Buyers of calls
2. Sellers of calls

[2] The calculations here ignore commissions paid by the trader.

[3] The calculations here ignore the effect of discounting. Theoretically, the \$10,000 should be discounted from the time of exercise to the purchase date when calculating the payoff.

3. Buyers of puts
4. Sellers of puts

Buyers are referred to as having *long positions*; sellers are referred to as having *short positions*. Selling an option is also known as *writing the option*.

1.6 HISTORY OF OPTIONS MARKETS

The first trading in put and call options began in Europe and in the United States as early as the eighteenth century. In the early years the market got a bad name because of certain corrupt practices. One of these involved brokers being given options on a certain stock as an inducement for them to recommend the stock to their clients.

Put and Call Brokers and Dealers Association

In the early 1900s a group of firms set up the Put and Call Brokers and Dealers Association. The aim of this association was to provide a mechanism for bringing buyers and sellers together. Traders who wanted to buy an option would contact one of the member firms. This firm would attempt to find a seller or writer of the option from either its own clients or those of other member firms. If no seller could be found, the firm would undertake to write the option itself in return for what was deemed to be an appropriate price.

The options market of the Put and Call Brokers and Dealers Association suffered from two deficiencies. First, there was no secondary market. The buyer of an option did not have the right to sell it to another party prior to expiration. Second, there was no mechanism to guarantee that the writer of the option would honor the contract. If the writer did not live up to the agreement when the option was exercised, the buyer had to resort to costly lawsuits.

The Formation of Options Exchanges

In April 1973 the Chicago Board of Trade set up a new exchange, the Chicago Board Options Exchange, specifically for the purpose of trading stock options. Since then options markets have become increasingly popular. By the early 1980s the volume of trading had grown so rapidly that the number of shares underlying the stock option contracts traded each day in United States exceeded the daily volume of shares traded on the New York Stock Exchange.

The exchanges trading options in the United States now include the Chicago Board Options Exchange (www.cboe.com), NASDAQ OMX (www.nasdaqtrader.com), NYSE Euronext (www.euronext.com), the International Securities Exchange (www.iseoptions.com), and the Boston Options Exchange (www.bostonoptions.com). Options trade on several thousand different stocks as well as stock indices, foreign currencies, and other assets.

Most exchanges offering futures contracts also offer options on these contracts. Thus, the CME Group offers options on corn futures, live cattle futures, and so on. Options exchanges exist all over the world (see the table at the end of this book).

The Over-the-Counter Market for Options

The over-the-counter market for options has grown very rapidly since the early 1980s and is now bigger than the exchange-traded market. One advantage of options traded in the over-the-counter market is that they can be tailored to meet the particular needs of a corporate treasurer or fund manager. For example, a corporate treasurer who wants a European call option to buy 1.6 million British pounds at an exchange rate of 1.5580 may not find exactly the right product trading on an exchange. However, it is likely that many derivatives dealers would be pleased to provide a quote for an over-the-counter contract that meets the treasurer's precise needs.

1.7 TYPES OF TRADER

Futures, forward, and options markets have been outstandingly successful. The main reason is that they have attracted many different types of trader and have a great deal of liquidity. When a trader wants to take one side of a contract, there is usually no problem in finding someone who is prepared to take the other side.

Three broad categories of trader can be identified: hedgers, speculators, and arbitrageurs. Hedgers use futures, forwards, and options to reduce the risk that they face from potential future movements in a market variable. Speculators use them to bet on the future direction of a market variable. Arbitrageurs take offsetting positions in two or more instruments to lock in a profit. As described in Business Snapshot 1.3, hedge funds have become big users of derivatives for all three purposes.

In the next few sections, we consider the activities of each type of trader in more detail.

1.8 HEDGERS

In this section we illustrate how hedgers can reduce their risks with forward contracts and options.

Hedging Using Forward Contracts

Suppose that it is May 13, 2015, and ImportCo, a company based in the United States, knows that it will have to pay £10 million on August 13, 2015, for goods it has purchased from a British supplier. The USD/GBP exchange rate quotes made by a financial institution are shown in Table 1.1. ImportCo could hedge its foreign exchange risk by buying pounds (GBP) from the financial institution in the three-month forward market at 1.5742. This would have the effect of fixing the price to be paid to the British exporter at $15,742,000.

Consider next another U.S. company, which we will refer to as ExportCo, that is exporting goods to the United Kingdom and on May 13, 2015, knows that it will receive £30 million three months later. ExportCo can hedge its foreign exchange risk by selling £30 million in the three-month forward market at an exchange rate of 1.5736. This would have the effect of locking in the U.S. dollars to be realized for the pounds at $47,208,000.

Business Snapshot 1.3 Hedge funds

Hedge funds have become major users of derivatives for hedging, speculation, and arbitrage. They are similar to mutual funds in that they invest funds on behalf of clients. However, they accept funds only from professional fund managers or financially sophisticated individuals and do not publicly offer their securities. Mutual funds are subject to regulations requiring that the shares be redeemable at any time, that investment policies be disclosed, that the use of leverage be limited, and so on. Hedge funds are relatively free of these regulations. This gives them a great deal of freedom to develop sophisticated, unconventional, and proprietary investment strategies. The fees charged by hedge fund managers are dependent on the fund's performance and are relatively high—typically 2 plus 20%, i.e., 2% of the amount invested plus 20% of the profits. Hedge funds have grown in popularity, with about $2 trillion being invested in them throughout the world. "Funds of funds" have been set up to invest in a portfolio of hedge funds.

The investment strategy followed by a hedge fund manager often involves using derivatives to set up a speculative or arbitrage position. Once the strategy has been defined, the hedge fund manager must:

1. Evaluate the risks to which the fund is exposed
2. Decide which risks are acceptable and which will be hedged
3. Devise strategies (usually involving derivatives) to hedge the unacceptable risks.

Here are some examples of the labels used for hedge funds together with the trading strategies followed:

Long/Short Equities: Purchase securities considered to be undervalued and short those considered to be overvalued in such a way that the exposure to the overall direction of the market is small.

Convertible Arbitrage: Take a long position in a thought-to-be-undervalued convertible bond combined with an actively managed short position in the underlying equity.

Distressed Securities: Buy securities issued by companies in, or close to, bankruptcy.

Emerging Markets: Invest in debt and equity of companies in developing or emerging countries and in the debt of the countries themselves.

Global Macro: Carry out trades that reflect anticipated global macroeconomic trends.

Merger Arbitrage: Trade after a possible merger or acquisition is announced so that a profit is made if the announced deal takes place.

Example 1.1 summarizes the hedging strategies open to ImportCo and ExportCo. Note that a company might do better if it chooses not to hedge than if it chooses to hedge. Alternatively, it might do worse. Consider ImportCo. If the exchange rate is 1.5000 on August 13 and the company has not hedged, the £10 million that it has to pay will cost $15,000,000, which is less than $15,742,000. On the other hand, if the exchange rate is 1.6000, the £10 million will cost $16,000,000—and the company will wish it had hedged! The position of ExportCo if it does not hedge is the reverse. If the exchange rate in August proves to be less than 1.5736, the company will wish it had hedged; if the rate is greater than 1.5736, it will be pleased it has not done so.

Example 1.1 Hedging with forward contracts

It is May 13, 2015. ImportCo must pay £10 million on August 13, 2015, for goods purchased from Britain. Using the quotes in Table 1.1, it buys £10 million in the three-month forward market to lock in an exchange rate of 1.5742 for the pounds it will pay.

ExportCo will receive £30 million on August 13, 2015, from a customer in Britain. Using quotes in Table 1.1, it sells £30 million in the three-month forward market to lock in an exchange rate of 1.5736 for the pounds it will receive.

This example illustrates a key aspect of hedging. Hedging reduces the risk, but it is not necessarily the case that the outcome with hedging will be better than the outcome without hedging.

Hedging Using Options

Options can also be used for hedging. Example 1.2 considers an investor who in May of a particular year owns 1,000 shares of a company. The share price is $28 per share. The investor is concerned about a possible share price decline in the next two months and wants protection. The investor could buy 10 July put option contracts on the company's stock with a strike price of $27.50. Each contract is on 100 shares. The position would therefore give the investor the right to sell a total of 1,000 shares for a price of $27.50. If the quoted option price is $1, each option contract would cost $100 \times \$1 = \$100$ and the total cost of the hedging strategy would be $10 \times \$100 = \$1{,}000$.

The strategy costs $1,000 but guarantees that the shares can be sold for at least $27.50 per share during the life of the option. If the market price of the stock falls below $27.50, the options will be exercised so that $27,500 is realized for the entire holding. When the cost of the options is taken into account, the amount realized is $26,500. If the market price stays above $27.50, the options are not exercised and expire worthless. However, in this case the value of the holding is always above $27,500 (or above $26,500 when the cost of the options is taken into account). Figure 1.4 shows the net value of the portfolio (after taking the cost of the options into account) as a function of the stock price in two months. The dotted line shows the value of the portfolio assuming no hedging.

Example 1.2 Hedging with options

It is May. An investor who owns 1,000 shares of a company and wants protection against a possible decline in the share price over the next two months. Market quotes are as follows:

Current share price: $28
July 27.50 put price: $1

The investor buys 10 put option contracts for a total cost of $1,000. This gives the investor the right to sell 1,000 shares for $27.50 per share during the next two months.

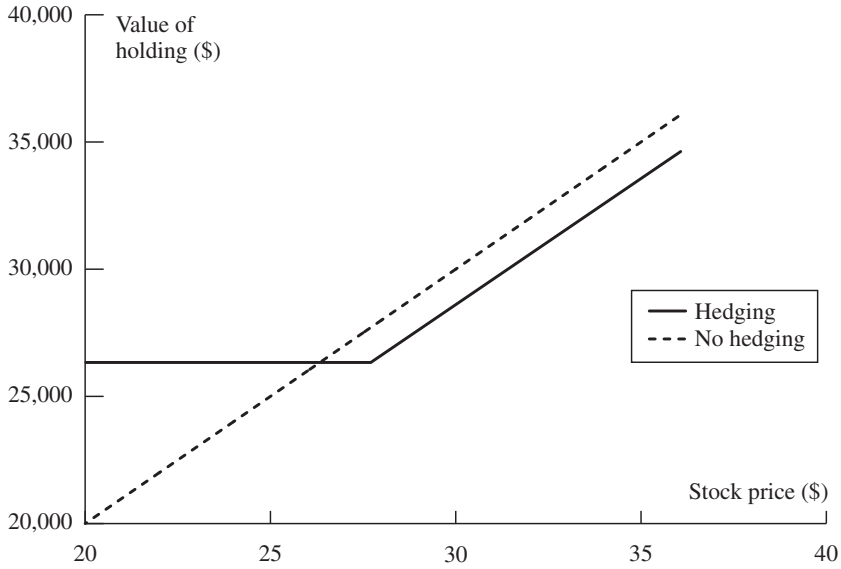

Figure 1.4 Value in Example 1.2 of the investor's holding in two months

A Comparison

There is a fundamental difference between the use of forward contracts and options for hedging. Forward contracts are designed to neutralize risk by fixing the price that the hedger will pay or receive for the underlying asset. Option contracts, by contrast, provide insurance. They offer a way for investors to protect themselves against adverse price movements in the future while still allowing them to benefit from favorable price movements. Unlike forwards, options involve the payment of an up-front fee.

1.9 SPECULATORS

We now move on to consider how futures and options markets can be used by speculators. Whereas hedgers want to avoid an exposure to adverse movements in the price of an asset, speculators wish to take a position in the market. Either they are betting that the price of the asset will go up or they are betting that it will go down.

Speculation Using Futures

Consider a U.S. speculator who in February thinks that the British pound will strengthen relative to the U.S. dollar over the next two months and is prepared to back that hunch to the tune of £250,000. One thing the speculator can do is purchase £250,000 in the spot market in the hope that the sterling can be sold later at higher price. (The sterling once purchased would be kept in an interest-bearing account.) Another possibility is to take a long position in four CME April futures contracts on sterling. (Each futures contract is for the purchase of £62,500.) Table 1.4 summarizes the two alternatives on the assumption that the current exchange rate is 1.5470 dollars

Table 1.4 Speculation using spot and futures contracts. One futures contract is on £62,500. Initial margin for four futures contracts = $20,000

	Possible Trade	
	Buy £250,000 *Spot price = 1.5470*	*Buy 4 futures contracts* *Futures price = 1.5410*
Investment	$386,750	$20,000
Profit if April spot = 1.6000	$13,250	$14,750
Profit if April spot = 1.5000	−$11,750	−$10,250

per pound and the April futures price is 1.5410 dollars per pound. If the exchange rate turns out to be 1.6000 dollars per pound in April, the futures contract alternative enables the speculator to realize a profit of $(1.6000 - 1.5410) \times 250{,}000 = \$14{,}750$. The spot market alternative leads to 250,000 units of an asset being purchased for $1.5470 in February and sold for $1.6000 in April, so that a profit of $(1.6000 - 1.5470) \times 250{,}000 = \$13{,}250$ is made. If the exchange rate falls to 1.5000 dollars per pound, the futures contract gives rise to a $(1.5410 - 1.5000) \times 250{,}000 = \$10{,}250$ loss, whereas the spot market alternative gives rise to a loss of $(1.5470 - 1.5000) \times 250{,}000 = \$11{,}750$. The alternatives appear to give rise to slightly different profits and losses, but these calculations do not reflect the interest that is earned or paid.

What then is the difference between the two alternatives? The first alternative of buying sterling requires an up-front investment of $386,750 (= 250,000 × 1.5470). By contrast, the second alternative requires only a small amount of cash—perhaps $20,000—to be deposited by the speculator in what is termed a margin account (this is explained in Chapter 2). The futures market allows the speculator to obtain leverage. With a relatively small initial outlay, a large speculative position can be taken.

Speculation Using Options

Options can also be used for speculation. Suppose that it is October and a speculator considers that a stock is likely to increase in value over the next two months. The stock price is currently $20, and a two-month call option with a $22.50 strike price is currently selling for $1. Table 1.5 illustrates two possible alternatives assuming that the speculator is willing to invest $2,000. One alternative is to purchase 100 shares.

Table 1.5 Comparison of profits from two alternative strategies for using $2,000 to speculate on a stock worth $20 in October

Speculator's strategy	*December stock price*	
	$15	*$27*
Buy 100 shares	−$500	$700
Buy 2,000 call options	−$2,000	$7,000

Another involves the purchase of 2,000 call options (i.e., 20 call option contracts). Suppose that the speculator's hunch is correct and the price of the stock rises to \$27 by December. The first alternative of buying the stock yields a profit of

$$100 \times (\$27 - \$20) = \$700$$

However, the second alternative is far more profitable. A call option on the stock with a strike price of \$22.50 gives a payoff of \$4.50, because it enables something worth \$27 to be bought for \$22.50. The total payoff from the 2,000 options that are purchased under the second alternative is

$$2{,}000 \times \$4.50 = \$9{,}000$$

Subtracting the original cost of the options yields a net profit of

$$\$9{,}000 - \$2{,}000 = \$7{,}000$$

The options strategy is, therefore, ten times more profitable than the strategy of buying the stock.

Options also give rise to a greater potential loss. Suppose the stock price falls to \$15 by December. The first alternative of buying stock yields a loss of

$$100 \times (\$20 - \$15) = \$500$$

Because the call options expire without being exercised, the options strategy would lead to a loss of \$2,000—the original amount paid for the options. Figure 1.5 shows the profit or loss from the two strategies as a function of the price of the stock in two months.

Options like futures provide a form of leverage. For a given investment, the use of options magnifies the financial consequences. Good outcomes become very good, while bad outcomes result in the whole initial investment being lost.

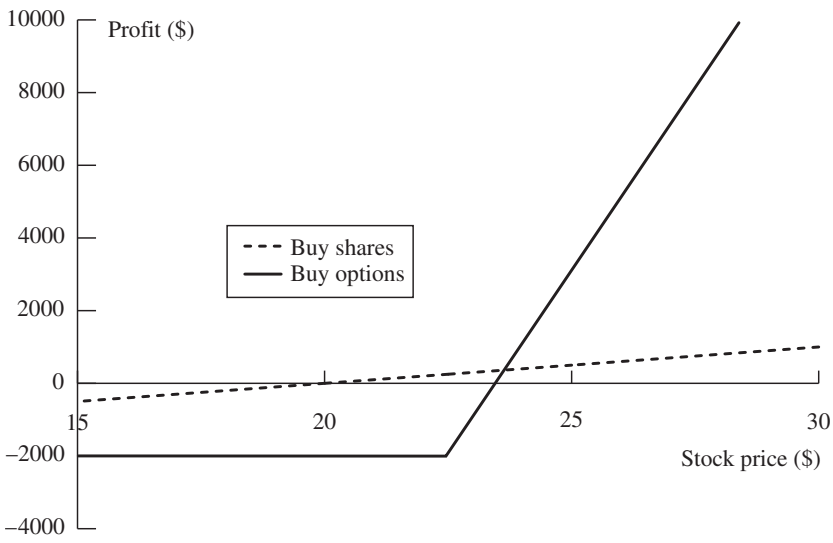

Figure 1.5 Profit or loss from two alternative strategies for speculating on a stock currently worth \$20

A Comparison

Futures and options are similar instruments for speculators in that they both provide a way in which a type of leverage can be obtained. However, there is an important difference between the two. When a speculator uses futures the potential loss as well as the potential gain is very large. When options are used, no matter how bad things get, the speculator's loss is limited to the amount paid for the options.

1.10 ARBITRAGEURS

Arbitrageurs are a third important group of participants in futures, forward, and options markets. Arbitrage involves locking in a riskless profit by simultaneously entering into transactions in two or more markets. In later chapters we will see how arbitrage is sometimes possible when the futures price of an asset gets out of line with its spot price. We will also examine how arbitrage can be used in options markets. This section illustrates the concept of arbitrage with a very simple example.

Example 1.3 considers a stock that is traded in both New York and London. Suppose that the stock price is \$152 in New York and £100 in London at a time when the exchange rate is \$1.5500 per pound. An arbitrageur could simultaneously buy 100 shares of the stock in New York and sell them in London to obtain a risk-free profit of

$$100 \times [(\$1.55 \times 100) - \$152]$$

or \$300 in the absence of transactions costs. Transactions costs would probably eliminate the profit for a small trader. However, a large investment bank faces very low transactions costs in both the stock market and the foreign exchange market. It would find the arbitrage opportunity very attractive and would try to take as much advantage of it as possible.

Arbitrage opportunities such as the one in Example 1.3 cannot last for long. As arbitrageurs buy the stock in New York, the forces of supply and demand will cause the

Example 1.3 An arbitrage opportunity

A stock is traded in both New York and London. The following quotes have been obtained:

New York: \$152 per share
London: £100 per share
Value of £1: \$1.5500

A trader does the following:

1. Buys 100 shares in New York
2. Sells the shares in London
3. Converts the sale proceeds from pounds to dollars.

This leads to a profit of

$$100 \times [(\$1.55 \times 100) - \$152] = \$300$$

dollar price to rise. Similarly, as they sell the stock in London, the sterling price will be driven down. Very quickly the two prices will become equivalent at the current exchange rate. Indeed, the existence of profit-hungry arbitrageurs makes it unlikely that a major disparity between the sterling price and the dollar price could ever exist in the first place. Generalizing from this example, we can say that the very existence of arbitrageurs means that in practice only very small arbitrage opportunities are observed in the prices that are quoted in most financial markets. In this book most of the arguments concerning futures prices, forward prices, and the values of option contracts will be based on the assumption that there are no arbitrage opportunities.

1.11 DANGERS

Derivatives are very versatile instruments. As we have seen they can be used for hedging, for speculation, and for arbitrage. It is this very versatility that can cause problems. Sometimes traders who have a mandate to hedge risks or follow an arbitrage strategy become (consciously or unconsciously) speculators. The results can be disastrous. One example of this is provided by the activities of Jérôme Kerviel at Société Général (see Business Snapshot 1.4).

To avoid the type of problems Société Général encountered it is very important for both financial and nonfinancial corporations to set up controls to ensure that derivatives are being used for their intended purpose. Risk limits should be set and the activities of traders should be monitored daily to ensure that the risk limits are adhered to.

Unfortunately, even when traders follow the risk limits that have been specified, big mistakes can happen. Some of the activities of traders in the derivatives market during the period leading up to the start of the credit crisis in July 2007 proved to be much riskier than they were thought to be by the financial institutions they worked for. As will be discussed in Chapter 8, house prices in the United States had been rising fast. Most people thought that the increases would continue—or, at worst, that house prices would simply level off. Very few were prepared for the steep decline that actually happened. Furthermore, very few were prepared for the high correlation between mortgage default rates in different parts of the country. Some risk managers did express reservations about the exposures of the companies for which they worked to the U.S. real estate market. But, when times are good (or appear to be good), there is an unfortunate tendency to ignore risk managers and this is what happened at many financial institutions during the 2006–2007 period. The key lesson from the credit crisis is that financial institutions should always be dispassionately asking "What can go wrong?", and they should follow that up with the question "If it does go wrong, how much will we lose?"

SUMMARY

In this chapter we have taken a first look at futures, forward, and options markets. Futures and forward contracts are agreements to buy or sell an asset at a certain time in the future for a certain price. Futures contracts are traded on an exchange, whereas forward contracts are traded in the over-the-counter market. There are two types of

Business Snapshot 1.4 SocGen's big loss in 2008

Derivatives are very versatile instruments. They can be used for hedging, speculation, and arbitrage. One of the risks faced by a company that trades derivatives is that an employee who has a mandate to hedge or to look for arbitrage opportunities may become a speculator.

Jérôme Kerviel joined Société Général (SocGen) in 2000 to work in the compliance area. In 2005, he was promoted and became a junior trader in the bank's Delta One products team. He traded equity indices such as the German DAX index, the French CAC 40, and the Euro Stoxx 50. His job was to look for arbitrage opportunities. These might arise if a futures contract on an equity index was trading for a different price on two different exchanges. They might also arise if equity index futures prices were not consistent with the prices of the shares constituting the index. (This type of arbitrage is discussed in Chapter 5.)

Kerviel used his knowledge of the bank's procedures to speculate while giving the appearance of arbitraging. He took big positions in equity indices and created fictitious trades to make it appear that he was hedged. In reality, he had large bets on the direction in which the indices would move. The size of his unhedged position grew over time to tens of billions of euros.

In January 2008, his unauthorized trading was uncovered by SocGen. Over a three-day period, the bank unwound his position for a loss of 4.9 billion euros. This was at the time the biggest loss created by fraudulent activity in the history of finance. (Later in the year, a much bigger loss from Bernard Madoff's Ponzi scheme came to light.)

Rogue trader losses were not unknown at banks prior to 2008. For example, in the 1990s, Nick Leeson, who worked at Barings Bank, had a mandate similar to that of Jérôme Kerviel. His job was to arbitrage between Nikkei 225 futures quotes in Singapore and Osaka. Instead he found a way to make big bets on the direction of the Nikkei 225 using futures and options, losing $1 billion and destroying the 200-year old bank in the process. In 2002, it was found that John Rusnak at Allied Irish Bank had lost $700 million from unauthorized foreign exchange trading. The lessons from these losses are that it is important to define unambiguous risk limits for traders and then to monitor what they do very carefully to make sure that the limits are adhered to.

options: calls and puts. A call option gives the holder the right to buy an asset by a certain date for a certain price. A put option gives the holder the right to sell an asset by a certain date for a certain price. Options trade both on exchanges and in the over-the-counter market.

Futures, forwards, and options have been very successful innovations. Three main types of participants in the markets can be identified: hedgers, speculators, and arbitrageurs. Hedgers are in the position of facing risk associated with the price of an asset. They use futures, forward, or option contracts to reduce or eliminate this risk. Speculators wish to bet on future movements in the price of an asset. Futures, forward, and option contracts can give them extra leverage; that is, the contracts can increase both the potential gains and potential losses in a speculative investment. Arbitrageurs are in business to take advantage of a discrepancy between prices in two different markets. If, for example, they see the futures price of an asset getting out of line with the spot price, they will take offsetting positions in the two markets to lock in a profit.

FURTHER READING

Chancellor, E. *Devil Take the Hindmost—A History of Financial Speculation*. New York: Farra Straus Giroux, 2000.

Merton, R. C. "Finance Theory and Future Trends: The Shift to Integration," *Risk*, 12, 7 (July 1999): 48–51.

Miller, M. H. "Financial Innovation: Achievements and Prospects," *Journal of Applied Corporate Finance*, 4 (Winter 1992): 4–11.

Zingales, L. "Causes and Effects of the Lehman Bankruptcy," Testimony before Committee on Oversight and Government Reform, United States House of Representatives, October 6, 2008.

Quiz (Answers at End of Book)

1.1. What is the difference between a long futures position and a short futures position?

1.2. Explain carefully the difference between (a) hedging, (b) speculation, and (c) arbitrage.

1.3. What is the difference between (a) entering into a long futures contract when the futures price is $50 and (b) taking a long position in a call option with a strike price of $50?

1.4. An investor enters into a short forward contract to sell 100,000 British pounds for U.S. dollars at an exchange rate of 1.5000 U.S. dollars per pound. How much does the investor gain or lose if the exchange rate at the end of the contract is (a) 1.4900 and (b) 1.5200?

1.5. Suppose that you write a put contract with a strike price of $40 and an expiration date in three months. The current stock price is $41 and one put option contract is on 100 shares. What have you committed yourself to? How much could you gain or lose?

1.6. You would like to speculate on a rise in the price of a certain stock. The current stock price is $29 and a three-month call with a strike price of $30 costs $2.90. You have $5,800 to invest. Identify two alternative strategies. Briefly outline the advantages and disadvantages of each.

1.7. What is the difference between the over-the-counter and the exchange-traded market? What are the bid and offer quotes of a market maker in the over-the-counter market?

Practice Questions

1.8. Suppose you own 5,000 shares that are worth $25 each. How can put options be used to provide you with insurance against a decline in the value of your holding over the next four months?

1.9. A stock when it is first issued provides funds for a company. Is the same true of an exchange-traded stock option? Discuss.

1.10. Explain why a futures contract can be used for either speculation or hedging.

1.11. A cattle farmer expects to have 120,000 pounds of live cattle to sell in three months. The live-cattle futures contract on the Chicago Mercantile Exchange is for the delivery of 40,000 pounds of cattle. How can the farmer use the contract for hedging? From the farmer's viewpoint, what are the pros and cons of hedging?

1.12. It is July 2016. A mining company has just discovered a small deposit of gold. It will take six months to construct the mine. The gold will then be extracted on a more or less continuous basis for one year. Futures contracts on gold are available on the New York Mercantile Exchange. There are delivery months every two months from August 2016 to December 2017. Each contract is for the delivery of 100 ounces. Discuss how the mining company might use futures markets for hedging.

1.13. Suppose that a March call option on a stock with a strike price of $50 costs $2.50 and is held until March. Under what circumstances will the holder of the option make a gain? Under what circumstances will the option be exercised? Draw a diagram showing how the profit on a long position in the option depends on the stock price at the maturity of the option.

1.14. Suppose that a June put option on a stock with a strike price of $60 costs $4 and is held until June. Under what circumstances will the holder of the option make a gain? Under what circumstances will the option be exercised? Draw a diagram showing how the profit on a short position in the option depends on the stock price at the maturity of the option.

1.15. It is May and a trader writes a September call option with a strike price of $20. The stock price is $18 and the option price is $2. Describe the trader's cash flows if the option is held until September and the stock price is $25 at this time.

1.16. An investor writes a December put option with a strike price of $30. The price of the option is $4. Under what circumstances does the investor make a gain?

1.17. The CME Group offers a futures contract on long-term Treasury bonds. Characterize the traders likely to use this contract.

1.18. An airline executive has argued: "There is no point in our using oil futures. There is just as much chance that the price of oil in the future will be less than the futures price as there is that it will be greater than this price." Discuss the executive's viewpoint.

1.19. "Options and futures are zero-sum games." What do you think is meant by this statement?

1.20. A trader enters into a short forward contract on 100 million yen. The forward exchange rate is $0.0080 per yen. How much does the trader gain or lose if the exchange rate at the end of the contract is (a) $0.0074 per yen; (b) $0.0091 per yen?

1.21. A trader enters into a short cotton futures contract when the futures price is 50 cents per pound. The contract is for the delivery of 50,000 pounds. How much does the trader gain or lose if the cotton price at the end of the contract is (a) 48.20 cents per pound; (b) 51.30 cents per pound?

1.22. A company knows that it is due to receive a certain amount of a foreign currency in four months. What type of option contract is appropriate for hedging?

1.23. A company in the United States expects to have to pay 1 million Canadian dollars in six months. Explain how the exchange rate risk can be hedged using (a) a forward contract; (b) an option.

1.24. A trader buys a call option with a strike price of $30 for $3. Does the trader ever exercise the option and lose money on the trade. Explain.

1.25. A trader sells a put option with a strike price of $40 for $5. What is the trader's maximum gain and maximum loss? How does your answer change if it is a call option?

1.26. "Buying a put option on a stock when the stock is owned is a form of insurance." Explain this statement.

Further Questions

1.27. Trader A enters into a forward contract to buy an asset for $1,000 in one year. Trader B buys a call option to buy the asset for $1,000 in one year. The cost of the option is $100. What is the difference between the positions of the traders? Show the profit as a function of the price of the asset in one year for the two traders.

1.28. On May 13, 2015, as indicated in Table 1.2, the spot offer price of Google stock is $532.34 and the offer price of a call option with a strike price of $525 and a maturity date of September is $30.40. A trader is considering two alternatives: buy 100 shares of the stock and buy 100 September call options. For each alternative, what is (a) the upfront cost, (b) the total gain if the stock price in September is $600, and (c) the total loss if the stock price in September is $500. Assume that the option is not exercised before September and if stock is purchased it is sold in September.

1.29. What is arbitrage? Explain the arbitrage opportunity when the price of a dually listed mining company stock is $50 (USD) on the New York Stock Exchange and $60 (CAD) on the Toronto Stock Exchange. Assume that the exchange rate is such that 1 USD equals 1.18 CAD. Explain what is likely to happen to prices as traders take advantage of this opportunity.

1.30. In March, a U.S. investor instructs a broker to sell one July put option contract on a stock. The stock price is $42 and the strike price is $40. The option price is $3. Explain what the investor has agreed to. Under what circumstances will the trade prove to be profitable? What are the risks?

1.31. A U.S. company knows it will have to pay 3 million euros in three months. The current exchange rate is 1.1500 dollars per euro. Discuss how forward and options contracts can be used by the company to hedge its exposure.

1.32. A stock price is $29. An investor buys one call option contract on the stock with a strike price of $30 and sells a call option contract on the stock with a strike price of $32.50. The market prices of the options are $2.75 and $1.50, respectively. The options have the same maturity date. Describe the investor's position.

1.33. The price of gold is currently $1,200 per ounce. Forward contracts are available to buy or sell gold at $1,400 per ounce for delivery in one year. An arbitrageur can borrow money at 5% per annum. What should the arbitrageur do? Assume that the cost of storing gold is zero and that gold provides no income.

1.34. Discuss how foreign currency options can be used for hedging in the situation described in Example 1.1 so that (a) ImportCo is guaranteed that its exchange rate will be less than 1.5900, and (b) ExportCo is guaranteed that its exchange rate will be at least 1.5500.

1.35. The current price of a stock is $94, and three-month European call options with a strike price of $95 currently sell for $4.70. An investor who feels that the price of the stock will increase is trying to decide between buying 100 shares and buying 2,000 call options (20 contracts). Both strategies involve an investment of $9,400. What advice would you give? How high does the stock price have to rise for the option strategy to be more profitable?

1.36. On May 13, 2015, an investor owns 100 Google shares. As indicated in Table 1.3, the bid share price is $532.20 and a December put option with a strike price of $500 costs $22.10. The investor is comparing two alternatives to limit downside risk. The first involves

buying one December put option contract with a strike price of \$500. The second involves instructing a broker to sell the 100 shares as soon as Google's price reaches \$500. Discuss the advantages and disadvantages of the two strategies.

1.37. A trader buys a European call option and sells a European put option. The options have the same underlying asset, strike price, and maturity. Describe the trader's position. Under what circumstances does the price of the call equal the price of the put?

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