CHAPTER 1

# Derivative Contracts and Markets

A *derivative contract* is a contractual agreement to execute an exchange at some future date. The term "derivative" arises from the fact that the agreement "derives" its value from the price of an underlying asset such as a stock, bond, currency, or commodity. A stock index futures derives its value from an underlying stock index, a foreign currency option derives its value from an underlying exchange rate, and so on. The key feature of the transaction specified in a derivative contract is that it will be executed in the future rather than today.

One can easily become overwhelmed by the apparently countless types of derivative contracts traded in the marketplace. The pages of the *Wall Street Journal* (*WSJ*) list the prices of tens of thousands of standardized, exchange-traded futures, options, and futures option contracts on hundreds of different underlying assets. And this only begins to scratch the surface. The *WSJ* reports only trading summaries for U.S. derivatives exchanges. Other exchanges worldwide have derivatives trading volume roughly equal to that in the United States. Moreover, the notional amount of exchange-traded derivatives worldwide represents only about 16% of all derivatives outstanding (i.e., USD 233.9 trillion as of December 2003). About 84% of derivatives are private contracts arranged with banks and various other financial houses. Many of these contracts are plain-vanilla forwards, swaps, caps, collars, or floors, but you will also hear of inverse floaters, protected equity notes, ratio swaps, time swaps, knockout options, spread locks, wedding-band swaps, and the like.

Do not be misled, however. Derivatives are not nearly as mystifying as they may seem. Fundamentally, there are only two different types of contracts—a forward and an option. A *forward* is a contract to buy or sell an underlying asset at some prespecified future date at a price agreed upon today. No money changes hands until the expiration date, at which time the buyer pays the amount of cash specified in the contract and the seller delivers the underlying asset. An *option* is also a contract to buy or sell an underlying asset at some prespecified future date at a price agreed upon today. Unlike a forward, however, the buyer of the option has the right but not the obligation to buy or sell the

underlying asset at the option's expiration. The seller's obligation depends on whether or not the buyer chooses to exercise the option.

The purpose of this chapter is to provide a general understanding of derivative contracts and derivative-contract market operation. We begin by describing and illustrating the nature of forward and option contracts. With these generic contract designs in mind, we then discuss fundamental issues such as why derivative contracts exist, how they originated, and where and how they trade.

## FORWARDS

A *cash* (or *spot*) *transaction* refers to an exchange of an asset that takes place *today*. The buyer pays the seller an agreed-upon price in cash and the seller delivers the asset. A *forward transaction*, on the other hand, is an agreement to an exchange that will take place in the future (i.e., at some time "forward"). No money changes hands today. The buyer and seller simply agree upon the terms of the exchange. The terms are formalized in a contract called a *forward*. The terms include (a) the price per unit of the asset that the buyer will pay the seller of the asset; (b) the number of units of the asset that will be delivered; and (c) the date on which the delivery will take place.[1] On the delivery date, the seller is contractually obliged to deliver the underlying asset to the buyer, and the buyer is obliged to pay the seller the prespecified price in cash.

To illustrate the mechanics of a forward transaction, suppose it is March and the price of a 180-day forward contract on 5,000 bushels of wheat is $3.00 a bushel.[2] If you buy this contract, you are agreeing to take delivery of 5,000 bushels of wheat in 180 days at a cost of $3.00 a bushel. You pay nothing today. You pay $15,000 in 180 days.

What motivates such a transaction? One possibility is *speculation*. Suppose that a meteorologist has, through his study of weather patterns over the past few months, become convinced that the summer will be very dry, and the Midwest will experience drought conditions. Under such conditions, he speculates that the size of the wheat harvest in the fall will be abnormally low and the price of wheat high. Indeed, he predicts that the price will be $5.00 a bushel in September. If, when September arrives, the price of wheat is $5.00 a bushel, he posts a *speculative gain*. While he pays $3.00 a bushel, or $15,000 in total, to take delivery of the wheat, he can turn around and sell it for $5.00 a bushel, thereby posting a $10,000 profit. But, if he makes $10,000, who loses? The answer is the person who sold him the forward contract (i.e., his *counterparty*). His counterparty gets paid $3.00 a bushel for delivering wheat now worth $5.00 a bushel in the spot market and thereby loses $10,000. Derivative contracts are a *zero-sum* game. What the buyer gains, the seller loses, and vice versa.

[1] Forward contracts also contain other terms such as the location of delivery or the method of settlement. These are not germane to the illustration at hand, however, and are therefore omitted.

[2] The fact that the intermediate gains (losses) of the futures position can (must) be invested (financed) leads to a small difference in the terminal values of a forward and a futures position. We discuss this matter in greater detail in Chapter 3.

Speculation is not the only motive for buying the wheat forward contract, however. The other motive is *hedging*. Often manufacturers commit to forward transactions with customers. Suppose a breakfast cereal producer commits to deliver 1,000 cases of a particular product at $25 a case to a grocery chain customer in September. Processing the wheat into cereal takes one day. To lock in the cost of the wheat for September production, the cereal producer can buy a forward contract expiring in September. Is he speculating? No, just the opposite. It is because the price of wheat in six months is uncertain that he buys the forward. Indeed, if he does not buy the forward, he is speculating that the price of wheat will fall. Buying a forward contract to lock in the price at which the asset will be acquired is known as an *anticipatory hedge*. The breakfast cereal producer is said to be a long hedger because he is buying (i.e., *going long*) the forward to hedge the price risk.

Someone's motive in buying the forward contract on wheat may be to speculate or to hedge, but what about the motive of his counterparty's motive? Is she speculating or hedging? The answer is one or the other. Suppose she is a farmer in the Midwest and has just seeded her land with wheat for September harvest. Standing in March, she faces two types of risk. She knows neither how plentiful her harvest will be nor the price per bushel at which she will be able to sell her crop. To hedge her price risk, she may want to sell a September wheat forward contract. If she does, she is said to be a *short hedger*, that is, she is selling (i.e., *going short*) the forward to lock in the price at which she can sell her crop. Is she speculating? No, again, just the opposite. She does not want to bet on the price at which she can sell her crop in September, so she sells the wheat forward. On the other hand, suppose your counterparty is involved in international grain trade and understands that there has been a significant increase in wheat production in virtually every grain-producing nation. Based on her knowledge about world oversupply, she predicts that the market price of wheat will be $2.00 a bushel in September. To act on her prediction, she may sell a forward contract on wheat for September delivery. If she does so, she is speculating. In September, she must buy 5,000 bushels of wheat in the cash market and then will deliver it to fulfill her obligation on the forward. If she is correct in her prediction, she will buy the wheat at $2.00 a bushel and then sell it at $3.00, thereby posting a $5,000 speculative gain.

The wheat forward contract described above has *delivery settlement*, that is, when the forward contract expires, the seller must deliver and the buyer must take delivery of the underlying asset. The forward contract will specify the location of delivery. For physical commodities such as wheat, the delivery process can be cumbersome and costly. The woman in the last example was speculating that the price of wheat would fall, and, when it fell as she predicted, she posted a *gross* speculative gain of $5,000. But, to realize her gain, she has to buy the wheat in the spot market for $2.00 a bushel and then transport it to the location specified in her forward contract. If such freight costs amount to, say, $1,000, her net gain from speculation is only $4,000.

To circumvent such costs, some derivative contracts specify *cash settlement* rather than delivery settlement. When the forward contract expires, the difference between the spot price and the forward price is paid in cash. If the spot price at the time of expiration exceeds the forward price, the short pays the dif-

ference in cash to the long. If the long is hedging and requires the delivery of the wheat, he will take his original commitment price (i.e., the forward price at inception) plus the profit on the forward trade to buy the commodity in the local spot market (thereby avoiding the transportation costs that may be associated with taking delivery at a different geographical location). Conversely, if the spot price at expiration is less than the forward price, the long pays the difference to the short. With cash settlement, the woman in the above illustration receives $5,000 in cash, thereby circumventing the cost (and the annoyance) of dealing with the delivery process. All derivative contracts including forwards specify whether settlement is *through delivery* or *in cash*. Absent significant delivery costs, the method of settlement is moot.

## Futures

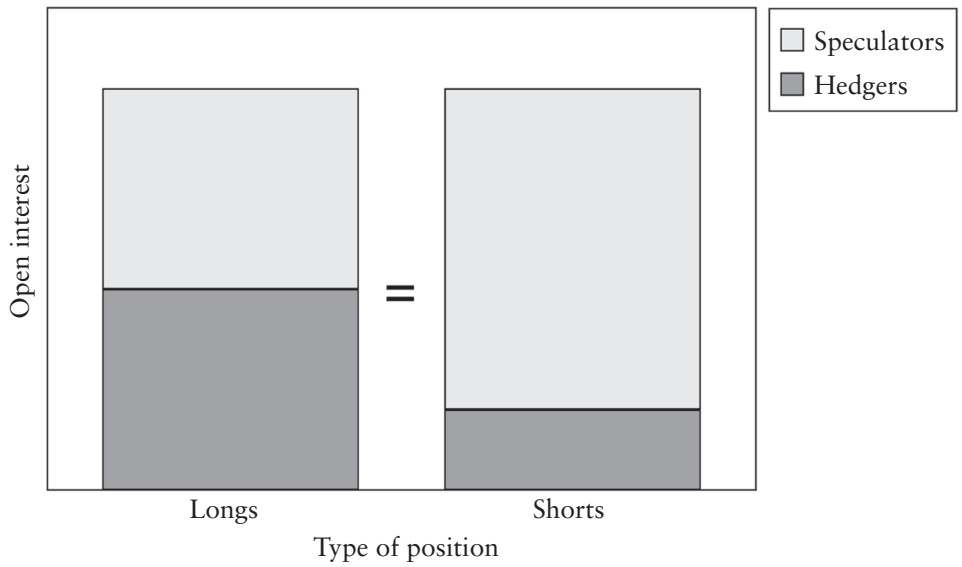
A *futures contract* is virtually identical to a forward contract. The only difference is that the gains and/or losses on a futures position are posted each day. Suppose that you see that the price of a wheat futures contract with two days to expiration and a denomination of 5,000 bushels is $3.00 a bushel. If you buy this contract, you are in effect agreeing to buy 5,000 bushels of wheat in two days at $3.00 a bushel. The payment is made in stages, however. Suppose that after one day the price of the futures (now with one day remaining to expiration) has risen to $3.50 a bushel. With a futures contract, you are immediately entitled to the $.50 per bushel gain and will receive a deposit of $2,500 in your trading account. This process is known as *marking-to-market* and occurs at the end of each trading day. Who pays? The answer is the person on the other side of your trade. He is marked-to-market with a $.50 a bushel loss.

Suppose that at the end of the second day the price of wheat is $4.50 a bushel. The marking-to-market process provides you a gain of $1.00 a bushel or $5,000. Since your futures contract has expired, you are required to buy 5,000 bushels of wheat at the market price of $4.50 a bushel, for a total cost of $22,500. But, you have already pocketed $7,500 in cash, so your net outlay is $15,000, or $3.00 a bushel. At the end of the second day, you are in the same position had you been if you had purchased a two-day forward contract at $3.00 a bushel. In most risk management applications, forwards and futures contracts can be used interchangeably.

## Open Interest

Figure 1.1 illustrates a concept called *open interest*. Suppose you consider all of the open positions in a given futures contract (e.g., the September wheat futures contract traded on the Chicago Board of Trade) on a given day. At any given time, by virtue of the fact that derivatives markets are a zero-sum game, the total number of contracts outstanding as long positions *must equal* the total number of contracts outstanding as short positions, as illustrated in Figure 1.1. The total number of contracts outstanding (long or short) is called *open interest*. The total number of long contracts can be broken down into two groups—hedgers who trade to lock in the price at which the asset can be purchased (i.e, long

**FIGURE 1.1** Breakdown of open interest between hedgers and speculators.




hedgers) and speculators who trade to benefit from an anticipated price increase. The total number of short contracts can also be broken down into two groups—hedgers who trade to lock in the price at which the asset can be sold (i.e., short hedgers) and speculators who trade to benefit from an anticipated price drop. The breakdown of the long and short positions in outstanding contracts between hedgers and speculators varies by underlying commodity and through time.

## OPTIONS

An option contract is the other fundamental type of derivative. Like a forward, an option is an agreement to exchange an underlying asset at a fixed price (called the option's *exercise price* or *striking price*) on some future date. Unlike a forward, however, an option provides the *right*, but not the *obligation*, to buy or sell the underlying asset.[3] The right to buy the underlying asset at a specified price on or before some specified future date is called a *call option*; the right to sell the underlying asset is called a *put option*. The amount that the option buyer pays the seller for the right is called the *option premium*.

To illustrate the mechanics of an option, suppose it is July and you predict that back-to-school software sales will drive Microsoft's share price from its current level of $25 a share to over $30 a share within three months. One way to act on your prediction is to buy a call option on the shares of Microsoft. You peruse the *Wall Street Journal* and find a Microsoft call that expires in October, has an exercise price of $30, has a contract denomination of 100 shares, and has a pre-

[3] Since an option is a right rather than an obligation, it is often referred to as a *contingent claim*.

mium of $2 a share. If you buy this call at $2.00 per share (i.e., a total option premium of $200), you have the right to buy 100 shares of Microsoft at $30 a share between now and October. If Microsoft's share price is above $30 when the contract expires, you will exercise your call by paying the option seller $3,000. The option seller, in turn, will deliver to you 100 shares of Microsoft, which you can sell at the prevailing market price. If the share price is $40 at expiration, your profit will be $1,000[4] less the original option premium, or $800.

Microsoft options, like all derivative contracts, are zero-sum games. The counterparty to your long call position is the seller of the option. The option seller received your original $200 premium payment. If the share price is $40 at expiration, he has to deliver shares worth $4,000 for $3,000 in cash. The option seller's (also called *option writer's*) loss is $800, exactly the amount you earned. If Microsoft's share price is less than $30 at the call's expiration, you will not exercise the call[5] (i.e., you will let it expire worthless). Under this scenario, your loss is $200, and the option seller's gain is $200.

Options are written on virtually every type of underlying asset, including stocks, bonds, currencies, and commodities. The nature of the underlying asset is usually used as a descriptor on the word "option." Options on stocks are called *stock options*, options on bonds *bond options*, options on currencies *currency options*, and so on. Options are also written on forward and futures contracts. The forward and futures contracts, in turn, are written on specific types of underlying assets. An option written on a stock index futures is called a *stock index futures option*, and an option written on a foreign currency forward contract is called a *currency forward option*.

## WHY DO DERIVATIVES MARKETS EXIST?

With a basic understanding of forward and option contracts in hand, we now turn to a critically important question—why do derivative contract markets exist? The answer is surprisingly simple. Derivative contracts exist because of trading costs or trading restrictions/regulations in the underlying asset market.

### Trading Costs

Trading costs are just that—costs incurred in a trade. Depending upon the type of market and the nature of the asset or derivative contract, trading costs vary. In general, however, the trading costs for derivative contracts are less than the trading costs for the underlying asset, holding the dollar value of the transaction constant. Consequently, cost-conscious risk managers prefer to trade derivatives rather than the underlying asset.

[4] Like forwards, options can be settled by delivery or in cash. In general, stock options traded on exchanges are delivery contracts. Stock index options, on the other hand, are generally cash settled.

[5] If you exercised the call, you would pay more than the current market price for the shares of Microsoft.

In securities markets, trading costs are incurred on transactions executed in both the primary and secondary markets. The *primary market* refers to the market in which securities are traded for the first time. These include *brand new issues* such as *initial public offerings* (or IPOs) of stocks, in which privately owned companies sell shares to the public for the first time or new bond offerings in which the firm floats new issue of debt, and *seasoned new issues* in which more units of an existing publicly traded security are issued. In either case, the firm enlists the help of an investment banker who *underwrites* the issue. For this service, he charges an underwriting fee. In most cases, this underwriting fee is a fairly significant proportion of the issue proceeds.

To illustrate the trading cost savings afforded by derivatives markets, consider a firm that has a significant amount of floating rate debt in its capital structure. The firm's chief financial officer fears that interest rates are about to rise and that the firm's earnings after interest will fall. Consequently, he decides to explore different hedging alternatives. One alternative is, of course, to retire the floating rate debt with a fixed rate bond issue. Issuing bonds, however, is expensive. The commission paid to the investment banker, together with the legal, auditing and printing costs associated with putting together a prospectus, average about 2.2% of issue proceeds.[6] Such costs can be avoided almost entirely by entering a *plain-vanilla interest rate swap* in which the firm agrees to receive a periodic floating rate and pay a periodic fixed rate. The market for interest rate swaps is very liquid, and trading costs can be as little as 4 basis points (0.04%).[7] From the firm's perspective, the risk management properties of the two strategies are virtually perfect substitutes. The costs of the two alternatives, however, differ by a factor of 55.

The *secondary market* refers to the market in which existing securities are traded. Securities exchanges, for example, are secondary markets. If you decide to buy or sell a security, you will incur at least two forms of trading costs: (a) a commission paid to the broker for executing the trade; and (b) the bid/ask spread charged by the market maker for providing immediacy of exchange. To execute a trade, you call your broker or sign in to your online brokerage service and place an order. The broker then turns around and communicates your order to the appropriate market maker. The market maker stands ready to buy at his quoted bid price and sell at his quoted ask price. The difference between the two prices is called the *quoted bid/ask spread* and represents the revenue the market maker earns for providing immediate exchange.[8] Once the order is consummated, the broker is informed, and he, in turn, informs you.

To illustrate the potential savings of the derivatives market in this case, suppose that you manage a portfolio of U.S. stocks and that you believe that the stock market will fall over the next month. After careful consideration, you decide that you want to eliminate entirely your stock market price risk exposure. One way to hedge the stock market risk is to sell all of your stocks and buy short-term money market instruments. Then, after you are convinced that the worst is over, you can liquidate your money market holdings and buy back your

[6] See Lee, Lochhead, Ritter, and Zhao (1996, p. 62, table 1).

[7] A basis point is 1/100 of 1%. Sample interest rate swap rates are reported in Table 1.8.

[8] In many electronic markets, buy and sell orders are matched automatically in the computer system of the exchange without the intermediation of market makers.

stocks. Another way to hedge this market risk exposure is to sell stock index futures contracts. This action, too, negates your market risk. When the worst is over, you unwind the hedge by buying an equivalent number of index futures. While these two strategies are equivalent in terms of their ability to hedge market risk, the second hedging strategy is much cheaper. In U.S. markets, the trading costs associated with the futures hedge are less than 1/20th of those incurred in liquidating and then buying back shares of stock.

## Trading Restrictions

Trading restrictions come in a variety of forms. Some arise because it is infeasible to trade the underlying asset. A farmer seeding his land in the spring for harvest in the fall, for example, has no means of selling his crop until it is harvested. Others arise from regulation. In Australia and Hong Kong, short-selling is permitted for only designated securities. In situations such as these, derivative contracts have been introduced to circumvent trading restrictions.

**Hedging by Selling an Unharvested Crop** Suppose that you are a farmer in the Midwest and have just seeded your land with wheat for a September harvest. Standing in March, you face *yield risk* (i.e., the number of bushels per acre your land will produce) and *price risk* (i.e., the price per bushel at which you will be able to sell your crop). Without derivative contracts, you have no means of offsetting either risk. With actively traded futures contracts traded on wheat, you can sell wheat futures and reduce the uncertainty of the revenue that you will earn at the time of harvest.

**Speculating by Circumventing Trading Restriction/Regulation** Suppose that you live in Australia and have noticed a frightening decline in beer consumption. Figuring that this decline will soon have an adverse effect on the earnings of Foster Brewing, you begin considering alternatives ways to profit from your belief. If you cannot short sell the shares of Foster Brewing on the Australian Stock Exchange, you cannot profit by trading in the stock market directly. It should not be surprising, therefore, to learn that the Sydney Futures Exchange was one of the first futures exchanges worldwide to launch trading in stock futures contracts. Selling stock futures enables individual investors to effectively short-sell stocks.

**Summary** Derivative contracts exist and, indeed, flourish because of trading costs and trading restrictions in the underlying asset market. Trading takes place for only two reasons—hedging or speculating. Hedging reduces risk and hence reduces expected return; speculation increases risk and hence increases expected return. Managing risk and return can be accomplished in only two ways—by changing the amount of the asset being held or by taking a position in derivative contracts written on the underlying asset. When both strategies are feasible, trading activity will tend to be concentrated in the lowest cost market, and the lowest cost market is usually the derivatives market. Sometimes, however, both strategies are not feasible. If an asset cannot be traded or if regulation limits the types of trades that can be placed, derivative contracts can serve as an effective substitute.

## EVOLUTION OF DERIVATIVES MARKETS

Derivatives, while seemingly new financial instruments, have actually been around for thousands of years. The earliest written example is contained in the Code of Hammurabi, a body of laws written by Hammurabi who reigned as king of Babylon from 1795 to 1750 BCE. Hammurabi's laws regulated all aspects of society. One law dealt with the relationship of farmers with their mortgage-holders, that is,

> 48. If any one owe a debt for a loan, and a storm prostrates the grain, or the harvest fail, or the grain does not grow for lack of water; in that year he need not give his creditor any grain, he washes his debt-tablet in water and pays no rent for the year.[9]

What this says, it seems, is that a typical farmer at the time carried a mortgage on his property and was required to make annual interest payments in the form of grain. In the event of crop failure, the farmer had the right to pay nothing and the mortgagor had no alternative but to forgive the interest. This decree by the king gave grain farmers an asset-or-nothing put option.[10] If the harvest was plentiful and the farmer had enough grain to pay his mortgage interest, the put option would expire worthless. If his harvest fell short, however, he would exercise his right to walk away from making the payment.

Another example of early derivatives use appears in Aristotle's *Politics* (350 BCE). Aristotle tells the story of Thales, a philosopher (and reasonably good meteorologist) who, based on studying the winter sky, predicted an unusually large olive harvest.[11] He was so confident of his prediction that he bought rights to rent all of the olive presses in the region for the following fall. The fall arrived, and the harvest was unusually plentiful. The demand and price for the use of olive presses soared.

These anecdotes serve to show that, while derivatives are sometimes thought of as being recent innovations, they have been used throughout recorded history. Hammurabi's put and Thales' call are examples of *over-the-counter* (OTC) derivatives. OTC derivatives are private contracts negotiated between parties. In the first example, the farmer bought, and the mortgagor sold, the asset-or-nothing put. The put premium was presumably embedded in the amount of the mortgage payment negotiated between the buyer and the seller. In the second example, Thales bought, and the olive press owners sold, call options. The prices of the options were negotiated, and Thales paid for them in the form of cash deposits. The chief advantage of OTC derivatives markets is the limitless flexibility in contract design. The underlying asset can be anything, the size of the contract can be any amount, and the delivery can be made at any time and in any location. All that an OTC contract requires is a willing buyer and a willing seller.

Among the disadvantages of OTC markets, however, is that willing buyers and sellers must spend time identifying each other. Thousands of years ago, before the

[9] The Avalon Project at the Yale Law School has made the Code of Hammurabi available on the website http://www.yale.edu/lawweb/avalon/hamcode.htm.
[10] All-or-nothing options are discussed in detail in Chapters 5 and 6.
[11] See *Politics* by Aristotle (1885, Book 1, Part XI).

advent of high-speed communication and computer technology, such searches were costly. Consequently, *centralized markets* evolved. The Romans organized commodity markets with specific locations and fixed times for trading. Medieval fairs in England and France during the 12th and 13th centuries served the same purpose. While centralized commodity markets were originally developed to facilitate immediate cash transactions, the practice of contracting for future delivery (i.e., forward transactions) was also introduced. So, while the contracts remained over-the-counter, there was at least some agreement about where the "counters" were.

Another disadvantage of OTC derivatives is *credit risk*, that is, the risk that a counterparty will renege on his contractual obligation. Perhaps the most colorful example of this type of risk involves forward and option contracts on tulip bulbs. In what can be characterized as a *speculative bubble*, rare and beautiful tulips became collectors' items for the upper class in Holland in the early 17th century. Prices soared to incredible levels.[12] Homes, jewels, livestock—nothing was too precious that it could not be sacrificed for the purchase of tulip bulbs. In an attempt to cash in on this craze, it was not uncommon for tulip bulb dealers to sell bulbs for future delivery. They did so based on call options provided by tulip bulb growers. In this way, if bulb prices rose significantly prior to delivery, the dealers would simply exercise their options and acquire the bulbs to be delivered on the forward commitments at a fixed (lower) price. The tulip bulb growers also engaged in risk management by buying put options from the dealers. In this way, if prices fell, the growers could exercise their puts and sell their bulbs at a price higher than that prevailing in the market. In retrospect, both the tulip bulb dealers and growers were managing the risk of their positions quite sensibly.

Everything could have worked out just fine, except that the bubble burst in the winter of 1637 when a gathering of bulb merchants could not get the usual inflated prices for their bulbs. Panic ensued. Prices sank to levels of 1/100th of what they had once been. This set off an unfortunate chain of events. Individuals who had agreed to buy bulbs from dealers did not do so. Consequently, dealers did not have the cash necessary to buy the bulbs when the growers attempted to exercise their puts. Some legal attempts were made to enforce the contracts, but the bottom line was that it was "as difficult to get blood out of a tulip bulb as out of a turnip."[13] These contract defaults left an indelible mark on OTC derivatives trading.

By the 1800s, the pendulum had swung from undisciplined derivatives trading in OTC markets toward more structured and secured trading on organized exchanges. The first derivatives exchange in the United States was the Chicago Board of Trade (CBT), as is noted in Table 1.1. While the CBT was originally formed in 1848 as a centralized marketplace for exchanging grain, forward contracts were also negotiated. The earliest recorded forward contract trade was made on March 13, 1851 and called for 3,000 bushels of corn to be delivered in June at a price of one cent per bushel below the March 13 spot price.[14] Forward contracts had their drawbacks, however. They were not standardized according to quality or delivery time. In addition, as in the case of the tulip bulb fiasco, merchants and traders often did not fulfill their forward commitments.

[12] Garber (2000) provides a detailed account of tulip bulb prices during this period.
[13] Gastineau (1988, ch. 3, p.14).
[14] See Chicago Board of Trade (1994, ch.1, p.14).

**TABLE 1.1** Milestones in the history of derivative contract markets (with emphasis on U.S. markets)

1750 BCE

- Options to default on interest payments are described in the Code of Hammurabi.

350 BCE

- Options to rent olive presses are described in Aristotle's Politics.

1600 CE

- Forward and option contracts on tulip bulbs flourish in Holland. Tulip bulb prices collapse in the winter of 1637, causing significant contract default.

1848 CE

- Chicago Board of Trade (CBT) is formed to provide a centralized marketplace for cash and forward transactions in grains.

1865 CE

- CBT revamps forward markets by introducing futures contracts on agricultural commodities. These new contracts were standardized contracts in terms of quality, quantity, and time and place of delivery, and involved the use of a clearinghouse and a system of margining.

1870 CE

- New York Cotton Exchange (NYCE) is formed to trade futures on cotton.

1874 CE

- Chicago Produce Exchange (CPE) is formed to trade futures on butter, eggs, poultry, and other perishable products.

1878 CE

- London Corn Trade Association introduces the first futures contract in the United Kingdom.

1882 CE

- Coffee Exchange (CE) is formed by a group of coffee merchants to trade futures on coffee.

1898 CE

- Butter and egg dealers withdraw from the CPE to form the Chicago Butter and Egg Board (CBEB).

1904 CE

- Winnipeg Commodity Exchange (WCE) introduces first commodity (oat) futures contracts in Canada.

1919 CE

- São Paulo Commodities Exchange (BMSP) introduces first commodity futures in Brazil.
- CBEB becomes the Chicago Mercantile Exchange (CME).

1933 CE

- Commodity Exchange (COMEX) is formed and introduces first futures contract on a non-agricultural commodity—silver.

1952 CE

- October: London Metal Exchange (LME) lists the first metal (lead) futures contract in the United Kingdom.

1960 CE

- Sydney Futures Exchange (SFE), originally called the Greasy Wool Futures Exchange, is formed to trade greasy wool futures.

**TABLE 1.1** (Continued)

1961 CE

- September: CME introduces first futures contract on livestock—frozen pork bellies.

1972 CE

- February: CME introduces first futures contract written on a financial instrument—foreign currencies.

1973 CE

- April: CBT organizes the Chicago Board Options Exchange (CBOE) for the purpose of trading call options on 16 New York Stock Exchange (NYSE) common stocks. Trading begins in a small smokers' lounge overlooking the futures exchange.

1975 CE

- CBT introduces first interest rate futures contracts—Government National Mortgage Association (GNMA) futures.
- Montreal Exchange (ME) launches stock options in Canada.
- January: American Stock Exchange (AMEX) launches call options on stocks.
- June: Philadelphia Stock Exchange (PHLX) launches call options on stocks.

1976 CE

- Pacific Stock Exchange (PSE) launches stock options.
- Australian Options Market (AOA) is formed in Australia to list stock options.
- January: CME launches T-bill futures contracts.
- March: Toronto Stock Exchange (TSE) lists stock options in Canada.

1977 CE

- June: Put options on common stocks are listed for the first time in the United States on the CBOE, AMEX, PHLX, and PSE.
- August: CBT launches T-bond futures contracts.

1978 CE

- London Traded Options Market (LTOM) is formed and launches stock options.
- European Options Exchange (EOE), formed in November 1977, launches stock options in The Netherlands.
- November: New York Mercantile Exchange (NYMEX) introduces first energy futures—heating oil.

1980 CE

- International Petroleum Exchange (IPE) is formed in the United Kingdom to list futures on petroleum and petroleum products.
- First over-the-counter (OTC) Treasury bond option takes place.
- September: Toronto Futures Exchange (TFE) is formed to list futures contracts on financial assets in Canada.

1981 CE

- First over-the-counter (OTC) interest rate swap transaction takes place.
- December: CME introduces the first cash settlement futures contract—the Eurodollar futures.

1982 CE

- London International Financial Futures Exchange (LIFFE) is formed in the United Kingdom to trade futures on financial instruments.
- February: Kansas City Board of Trade (KCBT) introduces first futures on a stock index (the Value Line stock index).
- April: CME launches S&P 500 index futures.
- October: First options listed on instruments other than common stocks.
- CBOE and AMEX launch options on Treasury bonds, notes, and bills.
- CBT launches options on T-bond futures.
- Coffee, Sugar, and Cocoa (CSCE) launches options on sugar futures.

**TABLE 1.1** (Continued)

1982 CE
- COMEX launches options on gold futures.
- December: PHLX launch options on currencies.

1983 CE
- January: CME and New York Futures Exchange (NYFE) launch options on stock index futures.
- February: SFE launches futures on the All Ordinaries Share Price Index in Australia.
- March: CBOE launches options on stock indexes, and NYMEX launches crude oil futures.

1984 CE
- Singapore International Monetary Exchange (SIMEX) is inaugurated as the first financial futures exchange in Asia.
- May: LIFFE launches futures on the FT-SE index in the United Kingdom.
- December: NYMEX launches futures on unleaded gasoline.

1986 CE
- May: Hong Kong Futures Exchange launches futures on the Hang Seng Index.
- September: SIMEX launches futures on the Nikkei 225 Stock Average.

1987 CE
- August: NYMEX launches futures on liquefied propane.

1991 CE
- Notional amount of OTC derivatives trading surpasses exchange-traded derivatives.

1992 CE
- Credit derivative contracts begin trading in OTC market.

1996 CE
- March: NYMEX launches futures on electricity.

2004 CE
- March: CBOE launches futures contract written on CBOE Market Volatility Index (VIX).
- May: CBOE launches futures contract written on three-month S&P 500 realized variance.

In 1865, the CBT made three important changes to the structure of its grain trading market. First, it introduced the use of standardized contracts called *futures contracts*. Unlike forward contracts in which the parties are free to choose the terms of the contract, the terms of futures contracts are set by the exchange and are standardized with respect to quality, quantity, and time and place of delivery for the underlying commodity. By concentrating hedging and speculative demands on fewer contracts, the depth and liquidity of the market are enhanced. This facilitates position unwinding. If a party to a trade wants to exit his position prior to the delivery date of the contract, he need only execute an opposite trade (i.e., *reverse* his trade) in the same contract. There is no need to seek out the counterparty of the original trade and attempt to negotiate the contract's termination.

The second and third changes were made in an effort to promote *market integrity*. The second was the introduction of a *clearinghouse* to stand between

the buyer and the seller and guarantee the performance of each party. This crucial step eliminated the *counterparty risk* that had plagued OTC trading. In the event a buyer defaults, the clearinghouse "makes good" on the seller's position, and then holds the buyer's clearing firm liable for the consequences. The buyer's clearing firm, in turn, passes the liability onto the buyer's broker, and ultimately the buyer. Note that, at any point in time, the clearinghouse has no net position since there are as many long contracts outstanding as there are short. The third change was the introduction of a *margining system*. When the buyer and seller enter a futures position, they are both required to deposit good-faith collateral designed to show that they can fulfill the terms of the contract.

From the late 1800s through the early 1980s, the lion's share of derivatives trading took place on exchanges. Over most of this period, the dominant form of derivatives trading was with futures contracts, and the futures contracts were written primarily on agricultural commodities. The CBT began trading corn, oat, and wheat contracts in 1865. In 1870, the New York Cotton Exchange was formed by a group of cotton brokers and merchants to trade futures on cotton; in 1874, the Chicago Produce Exchange was formed by a group of agricultural dealers to trade futures on butter, eggs, and other perishable agricultural commodities; and, in 1882, the Coffee Exchange was formed by a group of coffee merchants who wished to avoid the risk of a cash market collapse by organizing a market for trading coffee futures. The first commodity futures contract in the United Kingdom was listed by the London Corn Trade Association in 1878, and the first contract in Canada was listed by the Winnipeg Commodity Exchange in 1904.

The move to nonagricultural commodities was slow. Indeed, more than 50 years elapsed before the Commodity Exchange (COMEX) in New York was formed in July 1933 to trade the first metals contract—silver futures. The London Metal Exchange (LME) launched lead futures in the United Kingdom in October 1952. The New York Mercantile Exchange (NYMEX) followed in the United States with platinum futures in December 1956 and palladium futures in January 1968. The introduction of futures on livestock occurred in the 1960s. The Chicago Mercantile Exchange (CME) launched pork belly futures in September 1961, live cattle futures in November 1964, and live hog futures in February 1966. Futures contracts on energy products did not emerge until November 1978, at which time the NYMEX introduced the heating oil futures contract. The International Petroleum Exchange (IPE) was formed in 1980 to make markets in futures on petroleum and petroleum products in the United Kingdom.

The pace of innovation in derivatives markets increased remarkably in the 1970s. Many of the important events occurring during this decade, as well as the next, are summarized in Table 1.1. The first major innovation occurred in February 1972, when the CME began trading futures on currencies in its International Monetary Market (IMM) division. This marked the first time a futures contract was written on anything other than a physical commodity. The second was in April 1973, when the CBT formed the Chicago Board Options Exchange (CBOE) to trade options on common stocks.[15] This marked the first time an option was traded on an exchange. The American Stock Exchange (AMEX) and

[15] Initially, only call options were listed in the United States. Put option trading were not listed until June 1977, and, even then, only on an experimental basis.

the Philadelphia Stock Exchange (PHLX) followed suit by listing options on U.S. stocks in 1975, and the Pacific Stock Exchange (PSE) in 1976. Other countries entered the picture around the same time. Options on the shares of Canadian stocks were listed by the Montreal Exchange in 1975 and the Toronto Stock Exchange in 1976. The Australian Options Market began listing stock options in 1976, and, in 1978, the London Traded Option Market (LTOM) was formed to list stock options in the United Kingdom. The third major innovation occurred in October 1975, when the CBT introduced the first futures contract on an interest rate instrument—Government National Mortgage Association futures. In January 1976, the CME launched Treasury bill futures, and, in August 1977, the CBT launched Treasury bond futures.

The 1980s brought yet another round of important innovations. The first was the use of cash settlement. In December 1981, the IMM launched the first cash settlement contracts, the 3-month Eurodollar futures. At expiration, the Eurodollar futures is settled in cash based on the interest rate prevailing for a 3-month Eurodollar time deposit.[16] Cash settlement made feasible the introduction of derivatives on stock index futures, the second major innovation of the 1980s. In February 1982, the Kansas City Board of Trade (KCBT) listed futures on the Value Line Composite stock index, and, in April 1982, the CME listed futures on the S&P 500. These contract introductions marked the first time that futures contracts were written on stock indexes. Other countries quickly followed suit. The Sydney Futures Exchange (SFE) listed futures on the All Ordinaries Share Price Index in February 1983, the London International Financial Futures and Options Exchange (LIFFE) listed futures on the FT-SE 100 in May 1984, the Hong Kong Futures Exchange (HKFE) listed futures on the Hang Seng Index in May 1986, and the Singapore International Monetary Exchange (SIMEX) listed futures on the Nikkei 225 Stock Average in September 1986. The third major innovation of the 1980s was the introduction of exchange-traded option contracts written on *underlyings*[17] other than individual common stocks.[18] The CBOE and AMEX listed interest rate options in October 1982 and the Philadelphia Stock Exchange (PHLX) listed currency options in December 1982. In the same year, options on futures appeared for the first time. In October 1982, the CBT began to list Treasury bond futures options, and the Coffee, Sugar, and Cocoa Exchange (CSCE) began to list options on sugar and gold futures. In January 1983, the CME and the New York Futures Exchange (NYFE) began to list options directly on stock index futures, and, in March 1983, the CBOE began to list options on stock indexes.

These two decades of innovation have had an enormous impact on the balance of derivatives trading activity on exchanges worldwide. While derivatives exchanges were originally developed to help market participants manage com-

[16] A Eurodollar time deposit is a U.S. dollar deposit in a London bank, and the interest rate quoted on such deposits is called the London Interbank Offer Rate (LIBOR). Since different banks may offer different rates on deposits of the same maturity, the settlement rate is based on an average of rates across banks.

[17] From this point forward, the term "underlying" refers to the asset or instrument that underlies the derivative contract.

[18] For a comprehensive review of these new option introductions and their economic purposes, see Stoll and Whaley (1985).

modity price risk, most of the trading activity today is concentrated in the risks of financial assets such as stocks, bonds, and currencies. Table 1.2 summarizes exchange-traded derivatives contract volume worldwide for the year 2003. Commodity futures accounted for about 17% of total futures volume worldwide, and commodity options accounted for less than 1%. At the same time, futures contracts on different interest rate instruments accounted for more than 55% of total futures volume and options on stocks/stock indexes accounted for more than 93% of total option volume. Thirty years ago, there were no exchange-traded derivatives on any financial asset at all.

The 1980s also saw the reemergence of OTC derivatives trading. With the derivatives on financial assets coming to the forefront, investment banks began to think of new ways to tailor contracts to meet customers' needs. Some ideas were standard forward and option contracts on financial instruments or indexes. In 1980, for example, the first OTC Treasury bond option was traded. Other contracts were seemingly new and different. Most fall under the generic heading, "swaps." A *swap contract* is a contract to exchange (or swap) a series of periodic future cash flows, where the terms of the contract are usually set such that the up-front payment is zero. The first *interest rate swap* was in 1981, when the Student Loan Marketing Association (Sallie Mae) swapped interest payments on intermediate-term, fixed rate debt for floating rate payments indexed to the three-month Treasury bill rate. The cash flows of the two legs of a swap can be linked to virtually any reference rate, asset price, or index level. A *basis rate swap*, for example, is an exchange of floating rate payments where the two floating rates are linked to, say, a three-month Treasury bill rate and a three-month Eurodollar time deposit rate, respectively. A *currency swap* is an exchange of interest payments (either fixed or floating) in one currency for payments (either fixed or floating) in another.[19] An *equity swap* involves the exchange of an inter-

**TABLE 1.2** Exchange-traded and over-the-counter derivatives activity during 2003.

| Underlying | Exchange-Traded Markets: Millions of Contracts Traded in 2003 | | | | OTC Markets: Notional Amount in Billions as of December 2003 | |
|---|---|---|---|---|---|---|
| | Futures | | Options | | | |
| Currencies | 59 | 2.06% | 14 | 0.28% | 24,484 | 12.42% |
| Interest rates | 1,577 | 55.37% | 302 | 5.80% | 141,991 | 72.01% |
| Equities | 726 | 25.48% | 4,843 | 92.94% | 3,787 | 1.92% |
| Commodities | 486 | 17.08% | 51 | 0.98% | 1,406 | 0.71% |
| Other | | | | | 25,510 | 12.94% |
| Total | 2,848 | 100% | 5,210 | 100% | 197,178 | 100% |

*Source:* This table was constructed from information provided in the Bank of International Settlements (www.bis.org), *BIS Quarterly Review*, June 2004.

[19] Currency swaps are unusual to the extent that the principal amounts are also usually exchanged at the beginning and the end of the swap. The principal amounts are typically chosen to be approximately equivalent at the prevailing spot rate when the contract is entered.

est rate payment and a payment based on the performance of a stock index, while an *equity basis swap* involves an exchange of payments on two different indexes. While swap agreements appear different from standard forward and option contracts, they are not new in the sense that each can be decomposed into a portfolio of forwards and options, as we discuss in great detail in subsequent chapters. What makes the swap attractive to the customer, however, is that one transaction can replace several.

Table 1.2 shows the notional amount of OTC derivatives outstanding at the end of 2003 by asset category. Clearly, the introduction of derivatives on financial assets has been crucial to the success of modern-day OTC derivatives markets. Interest rate derivatives accounted for about 72% of the USD 197.2 trillion of contracts outstanding at the end of 2003, and currency derivatives accounted for another 12.5%. In addition to using financial assets as the underlying, the "package" nature of swap agreements has met with widespread market approval. According to the Bank for International Settlements, the total notional amount of single-currency, interest rate derivatives outstanding worldwide as of December 2003 was USD 141.99 trillion with swaps being 78.32%, options 14.09%, and forwards 7.58%.

Another way to view the success of modern-day OTC derivatives markets is to compare the notional amount outstanding against exchange-traded derivatives.[20] At the beginning of 1980, virtually all derivatives traded were on exchanges. By 1991, the notional amount of derivatives traded in the OTC market was about equal to that of exchange-traded markets. According to the Bank for International Settlements, the total notional amount of derivatives outstanding worldwide as of December 2003 was USD 233.9 trillion, 15.7% being exchange-traded and 83.3% over-the-counter.

Does this enormous rate of growth in OTC markets imply the demise of exchange-traded derivative contract markets? Not necessarily. In many ways, the markets are complementary. In standing on the other side of customer transactions, investment banks wind up with large portfolios (i.e., "books") of OTC agreements. Some of the risks of the individual contracts in the dealer's book offset each other, however, at any point in time, the dealer's book is likely to have significant net exposures to equity, interest rate, currency, and/or commodity price risks. These exposures can be laid off conveniently and inexpensively using the standardized contracts that exchanges provide.

## ATTRIBUTES OF EXCHANGE-TRADED DERIVATIVE MARKETS

Exchange-traded derivatives arose in response to controversies such as the tulip bulb fiasco. The key ingredients to the success of exchange-traded derivative markets are: (1) standardized contracts, (2) a clearinghouse, (3) a system of margining, and (4) market transparency. After discussions of these attributes, we describe regulations governing exchanges in the United States and provide some examples of exchange-traded derivative contracts.

[20] The figures, compiled and reported by the Bank for International Settlements (BIS) may be somewhat misleading, as we discuss later in the chapter.

### Standardized Contracts

Exchange-traded contracts are standardized by underlying asset, time and location of delivery, method of settlement, and other factors. By concentrating trading activity in fewer types of contracts, the exchange promotes market depth and liquidity. Deep and liquid markets are desirable for two reasons. First, it permits secondary market trading "in size" with little impact on price. An OTC dealer with a large exposure to U.S. stock market risk, for example, can lay off that risk quickly and inexpensively using the CME's S&P 500 futures contracts. In addition, it permits easy *unwinding* of existing positions. If a farmer hedges his price risk by selling a September wheat futures contract on the CBT in the spring but later decides he wants to unwind his futures position before harvest, he can simply buy the same futures contract to offset (or reverse) his short position. In contrast, if the farmer sold a forward contract with the same terms in the OTC market, he would be faced with the prospect of calling the OTC derivatives dealer and negotiating his way out of the agreement. This places the farmer at a competitive disadvantage.[21]

The second reason that deep and liquid markets are important is that they limit the prospect of corners and short-squeezes. These are attempts to profit from futures trading by manipulating price. A *corner* refers to an individual or firm gaining control of the entire deliverable supply of the commodity underlying the futures. If this individual also simultaneously buys futures contracts, he may be attempting a *short-squeeze*. To understand how a short-squeeze works, recall that those who are short futures at the contract expiration must liquidate by either (a) delivering the underlying commodity or (b) buying an offsetting number of futures. In a short-squeeze, both actions are encumbered. The individual attempting the short-squeeze refuses to sell either the commodity or the futures. As the shorts[22] scramble to buy futures and cover their positions, the futures price rises. When the price rises high enough in the eyes of those squeezing the market, they sell their futures and realize their gains.

A telltale sign of an attempted short-squeeze is that the futures price in the delivery month rises relative to the prices of more distant contracts and to the underlying commodity price. Exchanges and the CFTC monitor futures markets for such signs in an attempt to guard against possible short-squeeze activity. If such activity is suspected, the person or firm undertaking the squeeze may be required to liquidate the long futures positions. The most recent example of a near short-squeeze was the attempt by an Italian grain-trading firm, Ferruzzi Finanziaria S.p.A., to corner the July 1989 soybean contract.[23] The July contract expired on July 19. At the beginning of July, Ferruzzi held more than half of the net long July futures positions, which was double the deliverable supply, and owned 85% of the

[21] OTC positions could also be offset by taking an opposite position with another OTC derivatives dealer. In this way, you can "shop around" to find the best terms. In contrast to exchange-traded derivatives where "two-sided" markets are quoted at all times, you will have to identify to the OTC dealer whether you plan to be a buyer or a seller before he quotes you the terms of the agreement.

[22] A "short" is someone who is currently short a futures or option contract. Conversely, a "long" is someone who is currently long.

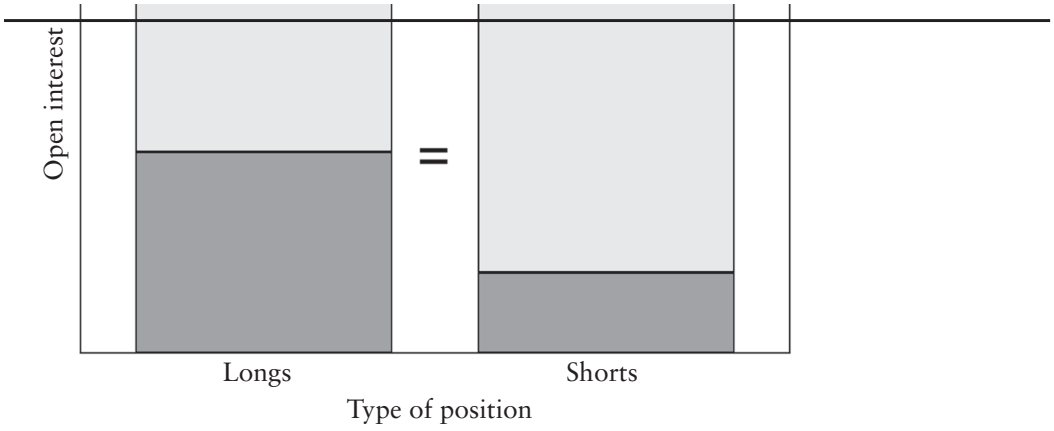
[23] See Chicago Board of Trade (1990). Daily price and open interest data for the soybean futures contracts traded during the period are contained in the Excel file, **Soybean Data (Ferruzzi).xls**.

soybeans in deliverable position. The shorts would have had to move massive amounts of soybeans to the approved delivery points (in Chicago and Toledo) in order to make delivery of their futures contracts, an impossible task in the short time remaining to expiration. In reaction to the potential corner, the Chicago Board of Trade ordered those holding futures positions in excess of 3 million bushels to liquidate. This meant that Ferruzzi had to sell much of its long position to the shorts, thereby avoiding a short-squeeze. July soybean futures prices, which had risen in reaction to the developing short-squeeze, fell back to normal levels. A more detailed account of the events is included in Appendix 1 of this chapter.

### The Clearinghouse

A second attribute that distinguishes an exchange from a OTC market is the clearinghouse. The role of a *clearinghouse* is to stand between the buyer and the seller and guarantee the transaction of each party. Figure 1.2 illustrates the process. The buyer and the seller agree to the price of the contract. Historically, this agreement has taken place on a trading floor, however, with the advent of computers and high-speed communication, most exchanges are now moving toward electronic trading. Regardless of where the agreement takes place, the buyer's and the seller's brokers then report the trade to their respective clearing firms. Some brokers are clearing firms. Those that are not simply clear their trades through firms that are. The clearing firms then report the trade to the clearinghouse. By interposing itself between the buyer and the seller, the clearinghouse acts as a guarantor by, in effect, becoming the party to whom delivery is made and from whom delivery is taken. In the event the buyer defaults, the clearinghouse "makes good" on the seller's position, and then holds the buyer's clearing firm liable for the consequences.[24] The buyer's clearing firm, in turn, passes the

**FIGURE 1.2** Derivatives trading on exchanges.




[24] The efficacy of clearinghouse operations depends critically on the solvency of the clearing members. To protect the integrity of operations, clearinghouses impose minimum capital requirements and position limits on clearing members, and exchanges set price limits on most contracts.

liability onto the buyer's broker, and ultimately the buyer. Note that the clearinghouse has no net position. At any point in time, there are as many long contracts outstanding as there are short. Note also that the exchange or clearinghouse's netting process is what allows customers to easily offset existing contract positions. If you buy (or sell) and then later sell (or buy) the same contract, your net position will be zero, and the position will disappear from your account statement. Any long option positions exercised during their life or at expiration will be randomly assigned to someone who has a short option position. Any deliveries made on open short futures positions during the delivery month will be either randomly assigned to open long positions or to the long position which has had the longest duration, depending on the contract. In the United States, all options exchanges use the same clearinghouse, that is, the Options Clearing Corporation (OCC). Historically, each U.S. futures exchange has had its own clearinghouse, although recently certain exchanges have agreed to a common clearing mechanism.[25]

### Margins

A third attribute that distinguishes an exchange from a OTC market is the imposition of margins. *Margin* is essentially a performance bond designed to show that you can fulfill your financial obligations resulting from your trade in the event that the market moves against you. Margins are of two types—*initial margin* and *maintenance margin*. The *initial margin* is the per contract amount deposited when you open a position. If the market moves against you on the opening day, your position is marked-to-market with a loss. The loss reduces the amount of your original deposit. If the balance in your account at the end of the day falls below a level called the *maintenance margin*, you will receive a *margin call* and will be required to bring the total amount of the margin back up to the initial margin level (as opposed to the maintenance margin level) by the opening of trading on the following morning. If you do not, your broker will reverse your position at the open of trading, and you will be held liable for the consequences. The incremental funds deposited to bring your account back to the initial level are called *variation margin*.

Initial and maintenance margins on the same underlying asset can vary depending on the nature of your position. With futures contract markets, for example, there may be separate initial and maintenance margin levels for (1) outright positions, (2) hedge positions, (3) intracommodity spreads, and (4) intercommodity spreads. *Outright positions* refer to buying or selling a futures with no other position in the underlying asset or in a related futures. In general, these margins are referred to as speculative margins and are the highest of the four positions listed. *Hedge positions* refer to selling (buying) the futures when you hold a long (short) position in the underlying asset. Since the riskiness of the individual legs of the hedge tend to offset each, hedge margins are lower

[25] In April 2003, for example, the CME signed an agreement with the CBT to provide clearing services for all CBT products. The clearing firm is now known as "The Clearing Corporation." In addition, The Clearing Corporation and the Options Clearing Corporation have a joint system for the clearing of stock futures.

than speculative margins. If a farmer can document the fact that he is in the business of growing wheat, his broker will likely require only hedge margin when the farmer sells wheat futures.[26] *Intracommodity* (or *calendar*) *spreads* refer to buying a futures and selling a futures on the same underlying asset but with different contract maturities. Since the trader is both long and short the same underlying, the risk of the position is negligible. Hence, the margin levels on intracommodity spreads are quite low. Finally, *intercommodity spreads* refer to buying a futures and selling a futures with the same maturity month but with a different (albeit related) asset. Buying a *crack spread*, for example, means buying a heating oil futures and selling a crude oil futures of the same maturity. The margin levels of such intercommodity spreads are generally lower than outright positions, but are considerably higher than intracommodity spreads.

It is important to recognize that cash balances held in your margin account should not be considered costly. Since you are allowed to post margin in the form of Treasury bills or, alternatively, since your broker may simply pay you a money market interest rate on your cash balance, your money is earning a fair rate of return.[27] Margin deposits are only costly when your broker does not allow Treasury bill deposits or is unwilling to pay a market interest rate on your cash deposit.

**ILLUSTRATION 1.1** Compute the margin balances in a futures account.

*Compute the margin account balances at the end of each day assuming that you sold outright 10 Canadian dollar futures on the CME at a price of USD 0.6760/CDN midday on June 1, 1999. The CME's contract denomination is CDN 100,000, and their initial and maintenance margin requirements on this contract are USD 675 and USD 500, respectively. Assume your broker pays 5% simple interest on your margin account balance. The subsequent prices of the futures over the next nine trading days are given in the table below.*

On June 1, 1999, you sold 10 contracts midday at a price of USD 0.6760/CDN. By the end of the day, the market has moved against your position and the settlement price is 0.6770. This means you will be marked-to-market with a USD 1,000 loss, that is, 0.001 per contract times 10 contracts times the CDN 100,000 contract denomination. This amount is netted from your initial margin deposit, leaving you with an ending balance on June 1 of USD 5,750.

On June 2, the futures price settles at 0.6787. Over the day, you earned USD 0.79 interest on your margin account balance, that is, USD 5,750 times 0.05 times 1/365. The futures price, again, moved adversely to your position, causing a mark-to-market loss of USD 1,700. Adding your previous end-of-day balance, your earned interest, and your mark-to-market adjustment, you have USD 4,050.79 in your margin account when the minimum required maintenance level is USD 5,000 (i.e., USD 500 per contract times 10 contracts). The exchange issues you a margin call, whereupon you must deposit enough extra funds (i.e., variation margin) to bring your account balance back up to the initial margin level. The variation margin payment is USD 2,699.21.

[26] A wheat farmer who buys wheat futures is said to be *Texas hedging*. In this case, the farmer would pay the speculative margin levels.

[27] In the third chapter, we review the mechanics of the capital asset pricing model (CAPM). The CAPM specifies the "fair" rate of return on an asset given its risk. The fair rate of return on a risk-free asset is the rate of return on a default-free security such as the Treasury bill rate.

On June 3, the futures settles at 0.6802. You have earned USD 0.92 interest and are marked-to-market with a USD 1,500 loss. Your account balance remains above USD 5,000 so no additional variation margin is necessary. You are not so lucky on June 4, when the futures settles at 0.6831. You earn USD 0.72 interest and are marked-to-market with a USD 2,900 loss. Your account balance, USD 4,398.36, is now below the maintenance margin level and you are required to bring the balance back up to the initial level of USD 6,750.

The remaining entries in the table are computed in a similar fashion. Larger amounts of interest are earned on June 7 and June 14 resulting from the 3 days of interest earned over the weekend.

**USD Margin Balances in Futures Account**

| End of Day | Settlement Price | Interest Earned | Mark-to-Market | Maintenance Check | Cash Deposit | Ending Balance |
|---|---|---|---|---|---|---|
| 6/1/1999 | 0.6770 | | –1,000.00 | | 6,750.00 | 5,750.00 |
| 6/2/1999 | 0.6787 | 0.79 | –1,700.00 | 4,050.79 | 2,699.21 | 6,750.00 |
| 6/3/1999 | 0.6802 | 0.92 | –1,500.00 | 5,250.92 | 0.00 | 5,250.92 |
| 6/4/1999 | 0.6831 | 0.72 | –2,900.00 | 2,351.64 | 4,398.36 | 6,750.00 |
| 6/7/1999 | 0.6837 | 2.77 | –600.00 | 6,152.77 | 0.00 | 6,152.77 |
| 6/8/1999 | 0.6827 | 0.84 | 1,000.00 | 7,153.62 | 0.00 | 7,153.62 |
| 6/9/1999 | 0.6818 | 0.98 | 900.00 | 8,054.60 | 0.00 | 8,054.60 |
| 6/10/1999 | 0.6867 | 1.10 | –4,900.00 | 3,155.70 | 3,594.30 | 6,750.00 |
| 6/11/1999 | 0.6873 | 0.92 | –600.00 | 6,150.92 | 0.00 | 6,150.92 |
| 6/14/1999 | 0.6879 | 2.53 | –600.00 | 5,553.45 | 0.00 | 5,553.45 |

The amounts of the initial and maintenance margin levels are set by the exchange and are different for different futures contracts.[28] Since the margin is designed only to protect the integrity of the market over a single day, the margin must be large enough to cover a reasonable range of price movements over a single day. Exchanges commonly set the initial margin to cover the mean absolute daily price change of the contract plus 3 standard deviations.[29] The mean absolute daily price change of the Canadian dollar futures contract during the month of June 1999 was 0.0019 and the standard deviation was 0.0017. This rule implies, therefore, that the initial speculative margin should be $(0.0019 + 3 \times 0.0017) \times 100{,}000$ or \$700 per contract, which is very close to the actual level of \$675. Note how both price volatility *and* contract size figure into the computation of the initial margin. Note also that with a pronounced change in price volatility, an exchange may elect to change the contract's margin levels.

## Transparency

A fourth important attribute of exchange-traded derivatives markets is that they are *transparent*—you can see what goes on. During the trading day, the price

[28] The margin levels set by the exchanges apply to the deposits made by clearing firms with the clearinghouse. The margin levels charged by brokers (and/or the clearing firms) to customers often exceed the exchange-mandated levels.

[29] See Edwards and Ma (1992, p.39).

quotes and trade prices/volumes stream across the screens of various on line data services. Then, at the end of the day, many financial publications such as the *Wall Street Journal* summarize each derivatives exchange's trading activity. An important figure provided to the financial press by the exchange's clearinghouse is the open interest in each contract. *Open interest* is a figure that expresses the amount of delivery that would take place if the contract was liquidated immediately.[30] To understand its computation each day, consider Table 1.3, which takes you through a hypothetical sequence of trades over five days. During the first day, A buys 30 contracts—10 from B, 5 from C, and 15 from D. The total trading volume over the day is 30 contracts.[31] The open interest is also 30 contracts. The total number of contracts outstanding is 30, which can be obtained by summing across all the open long positions (i.e., the total demand for delivery) *or* by summing across all the open short positions (i.e., the total supply promised).

**TABLE 1.3** Illustration of the computation of trading volume and open interest.

| Day | Buyer | Seller | Number of Contracts | End of Days | |
|---|---|---|---|---|---|
| | | | | Contract Volume | Open Interest |
| 1 | A | B | 10 | | |
| | A | C | 5 | | |
| | A | D | 15 | | |
| | | | | 30 | 30 |
| 2 | A | E | 15 | | |
| | B | A | 10 | | |
| | B | D | 20 | | |
| | | | | 45 | 55 |
| 3 | D | F | 40 | | |
| | F | G | 30 | | |
| | F | A | 15 | | |
| | | | | 85 | 50 |
| 4 | A | G | 20 | | |
| | D | B | 30 | | |
| | E | C | 25 | | |
| | | | | 75 | 90 |
| 5 | C | A | 40 | | |
| | G | B | 15 | | |
| | C | D | 10 | | |
| | | | | 65 | 60 |

[30] That is not to say that delivery *will* be made immediately. Open interest merely reflects the aggregate hedging and speculative demand in a particular commodity contract.

[31] Occasionally you will see the total trading volume reported by an exchange on such a day as 60 contracts. The rationale for such computation is that 30 contracts were purchased and 30 contracts were sold. For our purposes, we ignore this practice.

On the second day, A buys 15 more contracts but sells 10. Thus, his open long positions have increased from 30 to 35 contracts. B, on the other hand, entered the day short 10 contracts. He then proceeded to close his short position by buying 10 contracts and by buying 20 more contracts to enter a long position. At the end of the day, A is long 35 contracts and B is long 20 contracts, so the total open interest at the end of the second day is 55 contracts. Note that we could also arrive at the same open interest figure by considering only open short positions. At the end of the first day, B is short 10 contracts, C is short 5, and D is short 15. During day 2, B closes his short position, C does nothing, D sells 20 more contracts bringing his total to 25, and E establishes a new short position of 15 contracts. Summing across all open short positions, you have open interest of 5 + 35 + 15 or 55 contracts.

It is important to recognize that there is no direct linkage between trading volume and open interest. While open interest cannot change without trading volume, trading volume may increase, decrease or have no effect on the level of open interest prior to expiration. As a practical matter, open interest in delivery contracts such as grain futures tends to disappear prior to the delivery month. This reflects contract buyers and sellers reversing and closing their positions to avoid the transportation costs associated with accepting or making delivery of the underlying commodity. Open interest in cash settlement contracts, on the other hand, tends to carried into the delivery month and may even be quite large on the day before expiration. On the expiration day, all open positions are settled in cash and the open interest disappears.

## Regulation

In the United States, two regulatory bodies oversee derivatives traded on exchanges. The Securities and Exchange Commission (SEC) governs the markets for options on securities and the Commodity Futures Trading Commission (CFTC) governs futures and futures options. Option exchanges list options on stocks, bonds, and currencies, hence fall under the regulatory jurisdiction of the SEC. Futures and futures options exchanges fall under the jurisdiction of the CFTC. These regulatory authorities are both a blessing and a curse. On one hand, having the operation of exchanges monitored by a federal agency further enhances market integrity. The CFTC, for example, establishes *position limits* on the maximum number of contracts that a single trader may have at any one time. This safeguards against illicit activities such as short squeezes. On the other hand, these regulatory authorities may slow the pace of financial innovation. Each time an exchange considers introducing a new type of derivative contract, it must apply to the appropriate regulatory authority, specifying all terms and conditions of the contract, as well as explaining how its presence in the marketplace will benefit society. Such contract applications may go through several rounds of revision and take months (and sometimes years) to get approved.

### Examples of Exchange-Traded Derivatives

All derivatives exchanges summarize the trading activity of *all* of the contracts they list on a daily basis, and most make the summaries available on their internet websites. To provide a flavor for this type of information, we discuss three examples—stock options, U.S. Treasury-bond futures, and corn futures options. Many other examples appear in later chapters.

**Stock Options** The first example is options listed on the shares of Dell. Viewed in whole, exchange-traded options written on the same underlying asset are called an *option class*. Table 1.4A reports the prices of Dell stock options as of 1:53 PM (CST) on Tuesday, January 6, 2004 on the Chicago Board Options Exchange's website, www.cboe.com. At the time, Dell's shares had a quoted bid/ask spread of 35.05/35.06. The expiration month and the exercise price are reported in the columns headed "Calls" and "Puts." The first row in the table is for the January 2004 call and put with an exercise price of 5, as indicated by the prefix "04 Jan 5.00." By convention, all stock options traded in the United States expire on the Saturday following the third Friday of the contract month. The first five characters of the term in parenthesis is the option series ticker symbol. The call's ticker symbol, for example, is "DLYAA." Note that each ticker symbol in the table is unique. This is its identifier for trading purposes. Each ticker represents an option series, where an *option series* is identified by a unique triplet of attributes: (1) call or put, (2) exercise price, and (3) expiration day.

The table shows that neither the call nor the put traded on January 6, at least as of the time the prices were downloaded (i.e., their volumes of trading are 0). Both options have traded at some time in the past, however, since the call has open interest of 580 and the put has open interest of 245. The call has a bid/ask price quote of 30.00/30.10. The last trade price, 28.60, lies outside the option's prevailing bid/ask quotes. This merely indicates that the market price of the option has moved since the time of the last trade. When the last trade occurred cannot be inferred from the information in the table. All that can be inferred is that the trade did not occur on January 6, 2004. By exchange convention, each option contract is written on 100 shares of stock, although the option premiums are reported on a per share basis. The January 2004 call with an exercise price of 5, for example, has a quoted ask price of $30.10. If you were to buy this option, you would pay $3,010 for the right to buy 100 shares of Dell at $5 a share. All stock options traded in the United States are *American-style*, meaning that the buyer can exercised at any time up to and including the expiration day.[32]

Table 1.4A reveals two interesting characteristics about stock option markets. First, at-the-money options tend to be the most active. The table shows that more than 99 percent of call option trading volume and 85 percent of put option trading volume on January 6, 2004 was in option series with exercise prices between 32.50 and 37.50 (i.e., at-the-money options). Second, the total

[32] Many other styles of options exist. A *European-style* option, perhaps the most common, can be exercised only on the expiration date. A *Bermuda-style* option can be exercised on prespecified dates during the option's life.

**TABLE 1.4A** Summary of price, volume, and open interest information for Dell stock options drawn from www.cboe.com at 1:53 PM on Tuesday, January 6, 2004. Underlying stock has contemporaneous bid (ask) price of 35.05 (35.06).

| Calls | Last Sale | Bid | Ask | Vol | Open Int | Puts | Last Sale | Bid | Ask | Vol | Open Int |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 04 Jan 5.00 (DLY AA-E) | 28.60 | 30.00 | 30.10 | 0 | 580 | 04 Jan 5.00 (DLY MA-E) | 0.05 | 0.00 | 0.05 | 0 | 245 |
| 04 Jan 7.50 (DLY AU-E) | 27.40 | 27.50 | 27.60 | 0 | 935 | 04 Jan 7.50 (DLY MU-E) | 0.45 | 0.00 | 0.05 | 0 | 1,012 |
| 04 Jan 10.00 (DLY AB-E) | 25.60 | 25.00 | 25.10 | 0 | 2,554 | 04 Jan 10.00 (DLY MB-E) | 0.05 | 0.00 | 0.05 | 0 | 12,981 |
| 04 Jan 12.50 (DLY AV-E) | 22.30 | 22.50 | 22.60 | 0 | 1,872 | 04 Jan 12.50 (DLY MV-E) | 0.05 | 0.00 | 0.05 | 0 | 1,209 |
| 04 Jan 15.00 (DLY AC-E) | 19.90 | 20.00 | 20.10 | 0 | 2,886 | 04 Jan 15.00 (DLY MC-E) | 0.05 | 0.00 | 0.05 | 0 | 7,190 |
| 04 Jan 17.50 (DLY AW-E) | 17.30 | 17.50 | 17.60 | 0 | 2,554 | 04 Jan 17.50 (DLY MW-E) | 0.10 | 0.00 | 0.05 | 0 | 9,807 |
| 04 Jan 20.00 (DLY AD-E) | 14.50 | 15.00 | 15.10 | 0 | 10,362 | 04 Jan 20.00 (DLY MD-E) | 0.05 | 0.00 | 0.05 | 0 | 27,524 |
| 04 Jan 22.50 (DLQ AX-E) | 11.70 | 12.50 | 12.60 | 0 | 4,120 | 04 Jan 22.50 (DLQ MX-E) | 0.05 | 0.00 | 0.05 | 0 | 7,753 |
| 04 Jan 25.00 (DLQ AE-E) | 10.20 | 10.00 | 10.10 | 2 | 22,611 | 04 Jan 25.00 (DLQ ME-E) | 0.05 | 0.00 | 0.05 | 0 | 23,350 |
| 04 Jan 27.50 (DLQ AY-E) | 7.70 | 7.50 | 7.60 | 0 | 32,333 | 04 Jan 27.50 (DLQ MY-E) | 0.05 | 0.00 | 0.05 | 0 | 21,488 |
| 04 Jan 30.00 (DLQ AF-E) | 5.10 | 5.00 | 5.10 | 2 | 42,340 | 04 Jan 30.00 (DLQ MF-E) | 0.05 | 0.00 | 0.05 | 0 | 39,133 |
| 04 Jan 32.50 (DLQ AZ-E) | 2.65 | 2.55 | 2.65 | 140 | 47,599 | 04 Jan 32.50 (DLQ MZ-E) | 0.05 | 0.00 | 0.10 | 70 | 34,591 |
| 04 Jan 35.00 (DLQ AG-E) | 0.55 | 0.55 | 0.65 | 1,490 | 126,530 | 04 Jan 35.00 (DLQ MG-E) | 0.55 | 0.45 | 0.55 | 485 | 39,290 |
| 04 Jan 37.50 (DLQ AT-E) | 0.05 | 0.00 | 0.05 | 0 | 49,257 | 04 Jan 37.50 (DLQ MT-E) | 2.55 | 2.40 | 2.50 | 10 | 4,404 |
| 04 Jan 40.00 (DLQ AH-E) | 0.05 | 0.00 | 0.05 | 0 | 42,460 | 04 Jan 40.00 (DLQ MH-E) | 5.10 | 4.90 | 5.00 | 0 | 6,914 |
| 04 Jan 42.50 (DLQ AS-E) | 0.05 | 0.00 | 0.05 | 0 | 255 | 04 Jan 42.50 (DLQ MS-E) | 0.00 | 7.40 | 7.50 | 0 | 147 |
| 04 Jan 45.00 (DLQ AI-E) | 0.05 | 0.00 | 0.05 | 0 | 8,573 | 04 Jan 45.00 (DLQ MI-E) | 10.50 | 9.90 | 10.00 | 0 | 149 |
| 04 Jan 50.00 (DLQ AJ-E) | 0.10 | 0.00 | 0.05 | 0 | 9,076 | 04 Jan 50.00 (DLQ MJ-E) | 14.20 | 14.90 | 15.00 | 0 | 168 |
| 04 Feb 20.00 (DLY BD-E) | 14.90 | 15.00 | 15.20 | 0 | 1,313 | 04 Feb 20.00 (DLY ND-E) | 0.05 | 0.00 | 0.05 | 0 | 45 |
| 04 Feb 22.50 (DLQ BX-E) | 12.30 | 12.50 | 12.70 | 0 | 1,165 | 04 Feb 22.50 (DLQ NX-E) | 0.05 | 0.00 | 0.05 | 0 | 620 |
| 04 Feb 25.00 (DLQ BE-E) | 8.50 | 10.00 | 10.20 | 0 | 1,954 | 04 Feb 25.00 (DLQ NE-E) | 0.05 | 0.00 | 0.05 | 0 | 3,275 |
| 04 Feb 27.50 (DLQ BY-E) | 6.80 | 7.60 | 7.70 | 0 | 1,657 | 04 Feb 27.50 (DLQ NY-E) | 0.10 | 0.05 | 0.10 | 0 | 3,721 |
| 04 Feb 30.00 (DLQ BF-E) | 5.40 | 5.20 | 5.30 | 0 | 2,477 | 04 Feb 30.00 (DLQ NF-E) | 0.15 | 0.10 | 0.20 | 200 | 7,054 |
| 04 Feb 32.50 (DLQ BZ-E) | 3.20 | 3.00 | 3.10 | 438 | 15,854 | 04 Feb 32.50 (DLQ NZ-E) | 0.50 | 0.40 | 0.45 | 15 | 18,014 |
| 04 Feb 35.00 (DLQ BG-E) | 1.45 | 1.30 | 1.40 | 88 | 32,620 | 04 Feb 35.00 (DLQ NG-E) | 1.25 | 1.20 | 1.30 | 265 | 10,863 |
| 04 Feb 37.50 (DLQ BT-E) | 0.40 | 0.35 | 0.45 | 3,784 | 23,799 | 04 Feb 37.50 (DLQ NT-E) | 3.00 | 2.75 | 2.85 | 20 | 2,117 |

**TABLE 1.4A** (Continued)

| Calls | Last Sale | Bid | Ask | Vol | Open Int | Puts | Last Sale | Bid | Ask | Vol | Open Int |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 04 Feb 40.00 (DLQ BH-E) | 0.10 | 0.05 | 0.10 | 0 | 8,146 | 04 Feb 40.00 (DLQ NH-E) | 5.80 | 4.90 | 5.10 | 0 | 1,051 |
| 04 Feb 42.50 (DLQ BS-E) | 0.05 | 0.00 | 0.05 | 0 | 1,285 | 04 Feb 42.50 (DLQ NS-E) | 7.90 | 7.40 | 7.50 | 0 | 32 |
| 04 Feb 45.00 (DLQ BI-E) | 0.05 | 0.00 | 0.05 | 0 | 1,318 | 04 Feb 45.00 (DLQ NI-E) | 10.50 | 9.90 | 10.00 | 0 | 97 |
| 04 May 20.00 (DLY ED-E) | 15.00 | 15.10 | 15.20 | 0 | 2,194 | 04 May 20.00 (DLY QD-E) | 0.00 | 0.00 | 0.05 | 0 | 0 |
| 04 May 22.50 (DLQ EX-E) | 12.40 | 12.60 | 12.80 | 0 | 1,066 | 04 May 22.50 (DLQ QX-E) | 0.15 | 0.05 | 0.10 | 0 | 670 |
| 04 May 25.00 (DLQ EE-E) | 9.50 | 10.20 | 10.40 | 0 | 862 | 04 May 25.00 (DLQ QE-E) | 0.20 | 0.10 | 0.15 | 0 | 1,252 |
| 04 May 27.50 (DLQ EY-E) | 7.40 | 7.90 | 8.00 | 0 | 695 | 04 May 27.50 (DLQ QY-E) | 0.35 | 0.25 | 0.30 | 0 | 1,959 |
| 04 May 30.00 (DLQ EF-E) | 5.30 | 5.70 | 5.80 | 0 | 1,981 | 04 May 30.00 (DLQ QF-E) | 0.55 | 0.50 | 0.60 | 0 | 11,585 |
| 04 May 32.50 (DLQ EZ-E) | 3.90 | 3.70 | 3.90 | 0 | 2,664 | 04 May 32.50 (DLQ QZ-E) | 1.10 | 1.05 | 1.15 | 50 | 7,858 |
| 04 May 35.00 (DLQ EG-E) | 2.25 | 2.20 | 2.30 | 84 | 16,581 | 04 May 35.00 (DLQ QG-E) | 2.10 | 2.00 | 2.05 | 0 | 6,313 |
| 04 May 37.50 (DLQ ET-E) | 1.15 | 1.15 | 1.20 | 54 | 11,003 | 04 May 37.50 (DLQ QT-E) | 3.20 | 3.40 | 3.50 | 40 | 893 |
| 04 May 40.00 (DLQ EH-E) | 0.55 | 0.50 | 0.60 | 8 | 11,819 | 04 May 40.00 (DLQ QH-E) | 5.70 | 5.30 | 5.40 | 0 | 910 |
| 04 May 42.50 (DLQ ES-E) | 0.15 | 0.20 | 0.25 | 0 | 3,187 | 04 May 42.50 (DLQ QS-E) | 0.00 | 7.50 | 7.60 | 0 | 1,155 |
| 04 May 45.00 (DLQ EI-E) | 0.10 | 0.05 | 0.10 | 0 | 183 | 04 May 45.00 (DLQ QI-E) | 0.00 | 9.90 | 10.00 | 0 | 380 |
| 04 Aug 20.00 (DLY HD-E) | 0.00 | 15.20 | 15.30 | 0 | 0 | 04 Aug 20.00 (DLY TD-E) | 0.00 | 0.05 | 0.10 | 0 | 0 |
| 04 Aug 22.50 (DLQ HX-E) | 0.00 | 12.80 | 12.90 | 0 | 10 | 04 Aug 22.50 (DLQ TX-E) | 0.00 | 0.10 | 0.20 | 0 | 0 |
| 04 Aug 25.00 (DLQ HE-E) | 10.10 | 10.40 | 10.60 | 0 | 18 | 04 Aug 25.00 (DLQ TE-E) | 0.00 | 0.25 | 0.35 | 0 | 29 |
| 04 Aug 27.50 (DLQ HY-E) | 7.60 | 8.20 | 8.30 | 0 | 110 | 04 Aug 27.50 (DLQ TY-E) | 0.65 | 0.50 | 0.60 | 0 | 55 |
| 04 Aug 30.00 (DLQ HF-E) | 6.30 | 6.20 | 6.30 | 0 | 71 | 04 Aug 30.00 (DLQ TF-E) | 1.00 | 0.90 | 1.05 | 0 | 339 |
| 04 Aug 32.50 (DLQ HZ-E) | 4.40 | 4.40 | 4.50 | 0 | 221 | 04 Aug 32.50 (DLQ TZ-E) | 1.60 | 1.60 | 1.70 | 100 | 611 |
| 04 Aug 35.00 (DLQ HG-E) | 2.95 | 2.90 | 3.00 | 8 | 823 | 04 Aug 35.00 (DLQ TG-E) | 2.70 | 2.60 | 2.70 | 0 | 1,153 |
| 04 Aug 37.50 (DLQ HT-E) | 1.70 | 1.75 | 1.85 | 104 | 365 | 04 Aug 37.50 (DLQ TT-E) | 4.20 | 4.00 | 4.10 | 110 | 141 |
| 04 Aug 40.00 (DLQ HH-E) | 1.00 | 1.00 | 1.05 | 38 | 213 | 04 Aug 40.00 (DLQ TH-E) | 0.00 | 5.70 | 5.80 | 0 | 121 |
| 04 Aug 42.50 (DLQ HS-E) | 0.00 | 0.50 | 0.60 | 0 | 207 | 04 Aug 42.50 (DLQ TS-E) | 0.00 | 7.70 | 7.90 | 0 | 1 |
| 04 Aug 45.00 (DLQ HI-E) | 0.00 | 0.25 | 0.30 | 0 | 6 | 04 Aug 45.00 (DLQ TI-E) | 0.00 | 10.00 | 10.10 | 0 | 0 |
| Total | | | | 6,240 | 552,764 | | | | | 1,365 | 319,669 |

**TABLE 1.4B** Summary of price, volume, and open interest information for Dell leaps drawn from www.cboe.com at 1:53 PM on Tuesday, January 6, 2004. Underlying stock has contemporaneous bid (ask) price of 35.05 (35.06).

| Calls | Last Sale | Bid | Ask | Vol | Open Int | Puts | Last Sale | Bid | Ask | Vol | Open Int |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 05 Jan 5.00 (ZDE AA-E) | 29.30 | 30.00 | 30.20 | 0 | 237 | 05 Jan 5.00 (ZDE MA-E) | 0.00 | 0.00 | 0.15 | 0 | 0 |
| 05 Jan 10.00 (ZDE AB-E) | 25.30 | 25.10 | 25.30 | 0 | 1,000 | 05 Jan 10.00 (ZDE MB-E) | 0.05 | 0.00 | 0.15 | 0 | 1,316 |
| 05 Jan 15.00 (ZDE AC-E) | 17.90 | 20.20 | 20.40 | 0 | 1,464 | 05 Jan 15.00 (ZDE MC-E) | 0.10 | 0.00 | 0.15 | 0 | 4,597 |
| 05 Jan 17.50 (ZDE AW-E) | 18.70 | 17.80 | 18.00 | 0 | 570 | 05 Jan 17.50 (ZDE MW-E) | 0.20 | 0.05 | 0.15 | 0 | 1,044 |
| 05 Jan 20.00 (ZDE AD-E) | 13.70 | 15.40 | 15.60 | 0 | 5,759 | 05 Jan 20.00 (ZDE MD-E) | 0.25 | 0.15 | 0.25 | 0 | 4,618 |
| 05 Jan 22.50 (ZDE AX-E) | 11.90 | 13.10 | 13.30 | 0 | 3,021 | 05 Jan 22.50 (ZDE MX-E) | 0.60 | 0.30 | 0.40 | 0 | 6,358 |
| 05 Jan 25.00 (ZDE AE-E) | 11.00 | 10.90 | 11.10 | 0 | 6,291 | 05 Jan 25.00 (ZDE ME-E) | 0.65 | 0.60 | 0.70 | 50 | 7,969 |
| 05 Jan 27.50 (ZDE AY-E) | 8.20 | 8.90 | 9.00 | 0 | 11,869 | 05 Jan 27.50 (ZDE MY-E) | 1.00 | 1.00 | 1.10 | 0 | 4,784 |
| 05 Jan 30.00 (ZDE AF-E) | 6.40 | 7.00 | 7.20 | 0 | 18,903 | 05 Jan 30.00 (ZDE MF-E) | 1.75 | 1.60 | 1.70 | 0 | 7,978 |
| 05 Jan 32.50 (ZDE AZ-E) | 5.50 | 5.30 | 5.50 | 6 | 9,914 | 05 Jan 32.50 (ZDE MZ-E) | 2.65 | 2.35 | 2.50 | 0 | 6,032 |
| 05 Jan 35.00 (ZDE AG-E) | 4.00 | 3.90 | 4.10 | 13 | 47,104 | 05 Jan 35.00 (ZDE MG-E) | 3.60 | 3.40 | 3.60 | 0 | 16,575 |
| 05 Jan 37.50 (ZDE AT-E) | 2.90 | 2.80 | 2.90 | 76 | 8,299 | 05 Jan 37.50 (ZDE MT-E) | 5.10 | 4.80 | 5.00 | 0 | 1,605 |
| 05 Jan 40.00 (ZDE AH-E) | 1.90 | 1.90 | 2.00 | 72 | 19,980 | 05 Jan 40.00 (ZDE MH-E) | 6.50 | 6.40 | 6.60 | 0 | 3,127 |
| 05 Jan 42.50 (ZDE AS-E) | 1.35 | 1.25 | 1.35 | 50 | 2,990 | 05 Jan 42.50 (ZDE MS-E) | 8.90 | 8.20 | 8.40 | 0 | 1,418 |
| 05 Jan 45.00 (ZDE AI-E) | 0.75 | 0.80 | 0.90 | 0 | 7,157 | 05 Jan 45.00 (ZDE MI-E) | 12.30 | 10.30 | 10.50 | 0 | 1,132 |
| 05 Jan 50.00 (ZDE AJ-E) | 0.35 | 0.30 | 0.40 | 150 | 4,766 | 05 Jan 50.00 (ZDE MJ-E) | 15.60 | 14.90 | 15.00 | 0 | 2,833 |
| 06 Jan 20.00 (WDQ AD-E) | 16.40 | 16.20 | 16.40 | 0 | 1,078 | 06 Jan 20.00 (WDQ MD-E) | 0.55 | 0.55 | 0.65 | 0 | 426 |
| 06 Jan 22.50 (WDQ AX-E) | 0.00 | 14.10 | 14.40 | 0 | 220 | 06 Jan 22.50 (WDQ MX-E) | 0.95 | 0.90 | 1.00 | 0 | 391 |
| 06 Jan 25.00 (WDQ AE-E) | 12.30 | 12.20 | 12.40 | 10 | 543 | 06 Jan 25.00 (WDQ ME-E) | 1.50 | 1.35 | 1.45 | 0 | 311 |
| 06 Jan 27.50 (WDQ AY-E) | 10.80 | 10.40 | 10.60 | 0 | 642 | 06 Jan 27.50 (WDQ MY-E) | 2.40 | 1.95 | 2.05 | 0 | 476 |
| 06 Jan 30.00 (WDQ AF-E) | 8.50 | 8.70 | 9.00 | 0 | 1,310 | 06 Jan 30.00 (WDQ MF-E) | 2.80 | 2.70 | 2.80 | 20 | 1,249 |
| 06 Jan 32.50 (WDQ AZ-E) | 6.70 | 7.20 | 7.50 | 0 | 674 | 06 Jan 32.50 (WDQ MZ-E) | 3.80 | 3.60 | 3.80 | 0 | 5,498 |
| 06 Jan 35.00 (WDQ AG-E) | 5.50 | 5.90 | 6.10 | 0 | 7,414 | 06 Jan 35.00 (WDQ MG-E) | 5.40 | 4.80 | 4.90 | 0 | 8,683 |
| 06 Jan 37.50 (WDQ AT-E) | 4.40 | 4.80 | 5.00 | 0 | 369 | 06 Jan 37.50 (WDQ MT-E) | 7.10 | 6.10 | 6.20 | 0 | 4,621 |
| 06 Jan 40.00 (WDQ AH-E) | 3.40 | 3.80 | 4.00 | 0 | 3,826 | 06 Jan 40.00 (WDQ MH-E) | 9.40 | 7.50 | 7.80 | 0 | 834 |
| 06 Jan 42.50 (WDQ AS-E) | 2.55 | 2.95 | 3.10 | 0 | 801 | 06 Jan 42.50 (WDQ MS-E) | 0.00 | 9.20 | 9.50 | 0 | 695 |
| 06 Jan 45.00 (WDQ AI-E) | 2.10 | 2.30 | 2.45 | 0 | 1,642 | 06 Jan 45.00 (WDQ MI-E) | 11.10 | 11.10 | 11.30 | 0 | 1,911 |
| 06 Jan 50.00 (WDQ AJ-E) | 1.35 | 1.30 | 1.50 | 0 | 1,387 | 06 Jan 50.00 (WDQ MJ-E) | 15.10 | 15.20 | 15.40 | 0 | 1,188 |
| Total | | | | 377 | 169,230 | | | | | 70 | 97,669 |

open interest for calls, 552,764, exceeds that of puts, 319,669. In stock option markets, there seems to be greater interest in speculating that the stock price will rise rather than fall. Table 1.4B has the same columns as Table 1.4A. The only difference is that Table 1.4B contains "Leaps" written on Dell's stock. In the 1980s, the CBOE, in response to investor demand, began trading "Long-term Equity Anticipation Securities," or Leaps. Where stock options have times to expiration up to nine months, Leaps have times to expiration up to three years. As of January 6, 2004, Dell had leaps expiring in January 2005 and January 2006. When Dell's January 2004 stock options expire on January 17, 2004, leaps with a January 2007 expiration will be introduced. Note that there is significant open interest in long-term options. Apparently a large number of traders have long-term directional views on Dell's stock price.

**S&P 500 Futures** Table 1.5 reports a summary of the daily trading activity of the Chicago Mercantile Exchange's (CME's) S&P 500 futures contract on Friday, July 20, 2004. The data were downloaded from the CME's website, www.cme.com. The reporting conventions are different than those used for stock options. Futures exchanges provide daily summaries, showing the open, high, low and last trade prices as well as the settlement price of each futures/futures option contract. Some of the prices that appear have a suffix "B" or "A." Such prices are not trades but are quotes. If a bid price quote exceeds the highest trade price in a given day, it appears as the "high." Conversely, if the lowest ask price quote is beneath the lowest trade price as for the day, it appears as the low. The last trade and settlement prices may differ because of market movements between the time of the last trade and the market close. The settlement price is used for the marking-to-market of futures positions.

The leftmost column contains the contract month. The S&P 500 futures is on a quarterly contract expiration cycle and expire at the open on the third Friday of the contract month. Elsewhere on the exchange's website are the specifications of the contract. The S&P 500 futures has a multiplier of 250, which means that the September 2004 futures contract settled at a dollar value of $1{,}093.40 \times \$250 = \$273{,}425$ on July 20, 2004. With an estimated contract volume of 44,681, this means that approximately $12.2 billion of stocks traded hands through this contract on this day. Futures exchanges disseminate their daily summaries shortly after the market closes each day. At that time, precise figures on the trading volume and current open interest are not known. Consequently, the exchanges report an estimate volume as well as the actual volume and open interest for the previous day, as is shown in Table 1.5. The open interest (i.e., number of contracts outstanding) for the September 2004 futures is 579,019. Since each contract has a face value of $273,425, this means that the aggregate hedging and speculative demand for the S&P 500 index portfolio, as reflected by the September 2004 futures contract, exceeds $158 billion.

**Eurodollar Futures Options** Table 1.6 contains a market summary for the CME's Eurodollar futures option contracts traded on Friday, July 20, 2004. The table includes only activity for September 2004 call options and was downloaded from www.cme.com. Other call option contract expirations as well as put options are also available of the exchange's website. Options on futures are like

**TABLE 1.5** Summary of daily trading for S&P 500 futures contract drawn from www.cme.com for Friday, July 20, 2004.

| Month | Open | High | Low | Last | Settlement | Point Change | Estimated Volume | Prior Day | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Settlement | Volume | Open Interest |
| Sep04 | 1090.20 | 1099.20 | 1083.10 | 1094.00 | 1093.70 | 310 | 44,681 | 1090.60 | 57,203 | 579,019 |
| Dec04 | 1089.50 | 1099.00B | 1085.00 | 1098.00A | 1094.00 | 300 | 225 | 1091.00 | 6,547 | 12,623 |
| Mar04 | 1085.00 | 1101.40B | 1085.00 | 1098.40A | 1095.40 | 300 | 68 | 1092.40 | | 465 |
| Jun04 | ---- | 1104.50B | 1089.50A | 1101.50A | 1098.50 | 300 | | 1095.50 | | 268 |
| Sep04 | ---- | 1108.50B | 1093.50A | 1105.50A | 1102.50 | 300 | | 1099.50 | | 16 |
| Dec04 | ---- | 1113.00B | 1098.00A | 1110.00A | 1107.00 | 300 | | 1104.00 | | 16 |
| Mar04 | ---- | 1118.50B | 1103.50A | 1115.50A | 1112.50 | 300 | | 1109.50 | | 6 |
| Jun04 | ---- | 1124.00B | 1109.00A | 1121.00A | 1118.00 | 300 | | 1115.00 | | 6 |
| Total | | | | | | | 44,974 | | 63,750 | 592,419 |

options on assets except that when a futures option is exercised, a futures position rather than an asset is delivered.[33] The options are American-style, and expire together with the underlying futures on the second London business day before the third Wednesday of the contract month. Exercising a Eurodollar option before expiration results in the delivery of the underlying futures, with each futures contract having a denomination of 1 million dollars.[34]

The leftmost column of Table 1.6 contains the option's exercise price. The first row shows a value of 9625. This means that the call provides its holder to buy the underlying futures contract at an index level of 96.25.[35] To identify the rate of interest on the underlying Eurodollar time deposit, the index level is subtracted from 100. Thus, buying the September 2004 futures call option with an exercise price of 9800, means acquiring the right to lend your money at 100.00 – 98.00 = 2.00 beginning in September 2004, where the amount of your deposit is 1 million dollars. The cost of acquiring this right (using the last trade price for illustrative purposes) is 0.09% of par or 0.0009 cents per dollar of deposit times the 1 million dollar contract denomination of $900.

## ATTRIBUTES OF OTC DERIVATIVE MARKETS

Early derivatives use was in the form of OTC contracts. Markets lacked depth and liquidity, which meant that early unwinding of a contract involved negotiating with your counterparty, frequently at unfavorable terms. In addition, contract defaults were commonplace, undermining the integrity of the market. Gradually, exchange-traded derivatives markets took over. Having a centralized market with standardized contracts and transparency provided needed depth and liquidity. Having a clearinghouse with a system of margining provided needed assurance that the terms of contracts would be honored. Exchange-traded markets continued to dominate, reaching market dominance in 1970s and 1980s—a period of major financial innovation. Exchanges introduced derivatives on financial assets such as stocks, stock indexes, bonds, and currencies. In addition, contract designs were streamlined with the use of cash settlement. The banking community was quick to realize that they, too, could design such structures for customers. Indeed, they could design any type of contract the customer wanted without the encumbrance of obtaining regulatory approval. We now turn to describing the key attributes of OTC derivative contract markets: contract flexibility and the regulatory environment within which OTC derivatives markets

[33] The Eurodollar futures contract has a denomination of USD 1,000,000 and is cash-settled to the interest rate on a USD 1,000,000 Eurodollar deposit with three months to maturity. Its price is quoted as an index level and is created by subtracting the Eurodollar rate from 100. A price of 94.50 therefore means that the contract buyer is willing to lend USD 1,000,000 at 5.50 percent for a three-month period beginning on the date the futures contract expires.

[34] As a rule of thumb, futures options will expire in the month before the underlying futures if the futures is settled by delivery. If the underlying futures is cash settled, the futures options and the futures will both be cash settled in the contract month.

[35] Available space in the financial is limited, so various abbreviations are used. One abbreviation is that decimal points are excluded from the strike price. Another is that only two places to the right of the decimal are reported. The strike price of 9787 is actually 97.875.

**TABLE 1.6** Summary of daily trading for September 2004 Eurodollar futures call options traded drawn from www.cme.com for Friday, July 20, 2004.

| Strike | Open | High | Low | Last | Settlement | Point Change | Estimated Volume | Prior Day | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Settlement | Volume | Open Interest |
| 9625 | — | — | — | — | 1.8000 | 1.00 | | 1.79000 | | 1,050 |
| 9650 | — | — | — | — | 1.5500 | 1.00 | | 1.54000 | | 9,381 |
| 9675 | — | — | — | — | 1.3000 | 1.00 | | 1.29000 | | 612 |
| 9700 | — | — | — | — | 1.0500 | 1.00 | | 1.04000 | | 6,121 |
| 9725 | — | — | — | — | 0.8000 | 1.00 | | 0.79000 | | 3,434 |
| 9750 | — | — | — | — | 0.5500 | 0.75 | | 0.54250 | | 25,851 |
| 9775 | — | — | — | — | 0.3050 | 0.50 | | 0.30000 | | 56,199 |
| 9787 | 0.1850 | 0.1850 | 0.1850 | 0.1850 | 0.1875 | 0.50 | 900 | 0.18250 | 51 | 61,368 |
| 9800 | 0.0950 | 0.0950 | 0.0900 | 0.0900 | 0.0875 | UNCH | 5,455 | 0.08750 | 10,783 | 219,220 |
| 9812 | 0.0350 | 0.0400 | 0.0350 | 0.0350 | 0.0325 | –0.50 | 3,102 | 0.03750 | 17,890 | 226,158 |
| 9825 | 0.0150 | 0.0150 | 0.0150 | 0.0150 | 0.0125 | –0.25 | 3,050 | 0.01500 | 16,450 | 269,037 |
| 9837 | 0.0050 | 0.0050 | 0.0050 | 0.0050 | 0.0075 | UNCH | 1,400 | 0.00750 | 8,101 | 190,439 |
| 9850 | — | — | — | — | 0.0050 | UNCH | 3,450 | 0.00500 | 6,118 | 282,240 |
| 9862 | — | — | — | — | 0.0025 | UNCH | | 0.00250 | 1,000 | 227,693 |
| 9875 | — | — | — | — | CAB | UNCH | | CAB | | 271,862 |
| 9887 | — | — | — | — | CAB | UNCH | | CAB | | 215,882 |
| 9900 | — | — | — | — | CAB | UNCH | | CAB | | 135,934 |
| 9912 | — | — | — | — | CAB | UNCH | | CAB | | 9,610 |
| 9925 | — | — | — | — | CAB | UNCH | | CAB | | 59,567 |
| 9950 | — | — | — | — | CAB | UNCH | | CAB | | 6,756 |

operate. Discussions of the transparency and credit risk issues follow, along with descriptions to two actively traded OTC derivative contract designs.

### Contract Flexibility

The chief virtue of OTC markets is contract flexibility. A customer can virtually be assured that he can find someone who is willing to tailor a derivatives contract to meet his needs. You might go to your local wine merchant, for example, and negotiate a contract for the future delivery of Penfolds Bin 389 Cabernet Shiraz from South Australia though the grapes have not yet been harvested. As noted earlier in the chapter, however, the primary interest is not in commodities but rather in financial assets. As the OTC markets grew in the early 1980s, it quickly became apparent more structure was needed to help avoid the controversies of the past. A global trade association called the International Swaps and Derivatives Association (ISDA) was chartered in 1985,[36] and today ISDA has over 450 members (largely banks who make markets in OTC derivatives) in 37 countries on five continents. Its primary purpose is to encourage the prudent and efficient development of the privately negotiated derivatives business by, among other things, promoting practices conducive to the efficient conduct of the business, including the development and maintenance of derivatives documentation.

The ISDA derivatives documentation comes in two forms. Documents such as *2000 ISDA Definitions and Annex to the 2000 ISDA Definitions*[37] lay out the industry's "language" for communicating the terms of derivatives transactions. Other documents such as the *ISDA Master Agreement (Local Currency – Single Jurisdiction)* and the *ISDA Master Agreement (Multicurrency – Cross Border)* provide the text for actual contracts. If two parties are about to enter their first OTC derivative transaction with each other, they will first sign a general agreement called the *ISDA Master Agreement*. The purpose of this agreement is to specify the general (nontransaction specific) conditions under which all transactions between the two parties will be carried out. With the definitions and master agreement in hand, individual trades can be negotiated between parties and confirmed in writing within minutes. The faxed confirmation will contain references to the ISDA documents such as:

> The definitions and provisions contained in the 1991 ISDA Definitions (as published by the International Swaps and Derivatives Association, Inc.) are incorporated into this Confirmation.

and

> The Confirmation supplements, forms part of, and is subject to, the following ISDA Master Agreement:

[36] Originally the association was called the International Swap Dealers Association.

[37] See International Swap Dealers Association (2000a, 2000b). ISDA's website can be viewed at www.isda.org.

| | |
|---|---|
| Dated as of: | July 28, 2000 |
| Between: | Counterparty A |
| And: | Counterparty B |
| Master agreement number: | 12345 |

The rest of the confirmation will include the specific terms of the trade. Prior to reviewing the terms of specific types of OTC trades, however, it is worth discussing some other important attributes of the OTC market.

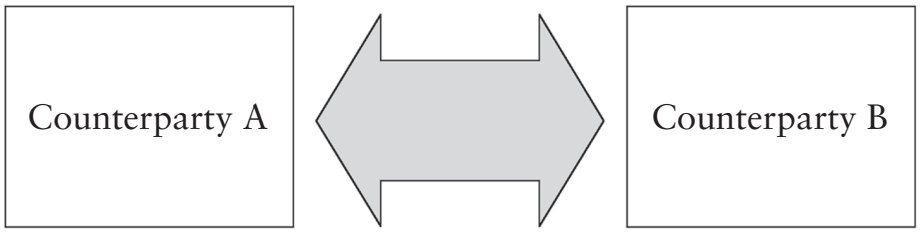
### Regulation

Aside from the self-imposed working standards of ISDA, OTC markets are unregulated. For OTC markets, the arguments regarding transparency are the opposite of what they were for exchanges. On one hand, trading participants in OTC derivatives markets do not have the extra layer of protection provided by a federal agency overseeing trading, making sure that everyone is operating according to the same set of rules and safeguarding against manipulative practices. On the other, OTC markets can introduce new types of derivative contracts at the drop of a hat—an important competitive advantage over exchanges that must seek governmental approval. All that an OTC transaction requires is a willing buyer and a willing seller.

### Transparency

*Market transparency* refers to the amount of information provided about the derivatives being traded. Exchange markets are transparent in the sense that information about trade prices, volumes, and open interest figures are publicly disseminated. OTC markets, on the other hand, are privately negotiated transactions. At any point in time, it is virtually impossible to predicted the amount of interest in a particular underlying commodity. Prior to the collapse of the tulip bulb derivatives trading in Holland, for example, no one could have gauged the full repercussions of the precipitous price decline. In an attempt to provide at least some transparency, both ISDA and the Bank for International Settlements (BIS) perform semiannual surveys of banks, asking that they itemize the notional amounts of outstanding derivatives positions by underlying asset and type of contract. Indeed, the OTC figures shown earlier in the chapter were drawn from the latest BIS survey. But surveys such as these are not comprehensive, take a long time to complete, and are reported with a considerable lag. In addition, notional amount is a misleading figure. The notional amount of an interest rate swap agreement, for example, is simply the principal amount upon which interest payments are computed. The market value of the agreement pales by comparison. Moreover, the aggregate notional amount (and even aggregate market value) are overstated since more than one bank may be reporting the same contract (i.e., the banks may be counterparties on the same trade). Nonetheless, looking at changes in notional amount through time, as well as the levels across asset categories, countries, and types of markets, is informative.

**FIGURE 1.3** OTC derivatives trading.




### Credit Risk

Unlike contracts in exchange markets, contracts in the OTC market have *credit risk*, that is, risk that your counterparty will default. We discussed some examples earlier in the chapter. The tulip bulb fiasco was caused by put option writers reneging on their obligation to buy bulbs from the growers. Similarly, futures markets evolved because traders and merchants sometimes did not fulfill promised deliveries on forward contracts. With OTC contracts, the parties are forced to deal with credit on their own. The counterparties to an OTC derivatives transaction (see Figure 1.3) are usually dealer versus user (i.e., a bank versus a firm) or dealer versus dealer (i.e., a bank versus a bank). Hence, the issue of creditworthiness is asymmetric. While large banks may be extremely creditworthy, some firms or smaller banks may not be.

One possible way to deal with credit risk is to trade only with creditworthy counterparties. A bank with such a credit risk policy may not be acting in the best interests of its shareholders, however, since there is probably a good deal of profitable trading that can be conducted with less creditworthy customers. Another way to handle credit risk is by asking the customer to provide a guarantor. Under such an arrangement, the firm will pay a premium (e.g., a fixed percentage of the notional amount) to a third party who acts as guarantor. Yet another way to handle the credit risk is to embed the expected cost of default by adjusting the terms of the contract.[38]

### Examples of OTC Derivative Contracts

Without standardized contracts and a central marketplace, finding information on OTC derivative contract specifications involves talking directly with OTC dealers. The terms of some generic types of instruments are well known. Below we describe two—plain-vanilla interest rates swaps and currency forward contracts.

**Plain-Vanilla Interest Rate Swap** The terms of a particular swap agreement are usually negotiated over the phone. Once an oral agreement is reached, the OTC derivatives dealer will fax a confirmation to the customer. Table 1.7 illustrates selected terms from the confirmation of a plain-vanilla, *fixed-for-floating* inter-

[38] Credit risk and credit risk derivatives are discussed in Chapter 19.

**TABLE 1.7** Selected terms from the confirmation of an OTC interest rate swap.

| | |
|---|---|
| The terms of the particular swap transaction to which this confirmation relates are as follows: | |
| Calculation amount | USD 30,000,000.00 |
| Trade date | July 28, 2000 |
| Effective date | August 1, 2000 |
| Termination date | August 1, 2005 |
| The fixed rate payer pays on each payment date an amount determined in accordance with the following: | |
| Fixed rate payer | BANK A |
| Payment dates | Commencing on February 1, 2001 and semiannually thereafter on the first calendar day of each calendar day of February and August up to and including the termination date. |
| Fixed rate | 7.036% |
| Fixed rate, day-count fraction | 30/360 |
| The floating rate payer pays on each payment date an amount determined in accordance with the following: | |
| Floating rate payer | COMPANY B |
| Payment dates | Commencing on February 1, 2001 and semiannually thereafter on the first calendar day of each calendar day of February and August up to and including the termination date. |
| Floating rate option | USD-LIBOR-LIBO |
| Designated maturity | 6 months |
| Reset dates | The first day of the relevant calculation period |
| Rounding factor | One hundred-thousandth of one percent |
| Floating rate, day-count fraction | Actual/360 |

est rate swap. The sheet is divided into three panels of information. The first panel provides the calculation amount, trade date, and termination date. The *calculation amount* is the notional amount upon which interest payments are computed. The *trade date* is the day on which the parties enter into the agreement, the *effective date* is the first day of the term of the agreement, and the *termination date* is the last day of the agreement.

The second and third panels of information specify obligations of the fixed rate and floating rate payers, respectively. The fixed rate payer, in this case, is BANK A, which promises to make semiannual, fixed interest payments at a rate of 7.036 percent. The "30/360" fixed rate, day-count fraction implies that each month (year) is assumed to have 30 (360) days. Thus, BANK A is obliged to pay COMPANY B an amount equal to

$$\$30{,}000{,}000 \times 0.07036 \times \frac{180}{360} = \$1{,}055{,}400$$

every six months for five years, with the first payment commencing on February 1, 2001.

At the same time, the floating rate payer, COMPANY B, is obliged to make semiannual interest payments on the same dates. The *floating rate option* is specified to be "USD-LIBOR-LIBO" and the *designated maturity* is 6 months. The term, USD-LIBOR-LIBO, is defined in the *Annex to the 2000 ISDA Definitions*[39] and means the offered rate on U.S. dollar deposits for the period of the designated maturity as they appear on the Reuters Screen LIBO Page. Since the *reset date* is the first day of the calculation period, the first floating rate payment becomes known as of the effective date of the swap. If the rate is 6.8125 percent on August 1, 2000, the floating rate interest payment on February 1, 2001 will be computed as follows. First, you compute the actual number of days between August 1, 2000 and February 1, 2001. The actual number of days is 184. Next, we compute the semiannual interest rate by taking the annual interest rate, 6.8125 percent, and multiplying by the *floating rate, day-count fraction*,

$$\frac{184}{360}$$

to get percent, which gets rounded to 3.48194 percent by virtue of the stated *rounding factor*. The floating rate payment that COMPANY B is obliged to make on February 1, 2001 is $1,044,582. The fixed rate and floating rate payments are then *netted* so that only one party pays on a particular payment date. In our illustration, this means BANK A will pay COMPANY B $10,818 on February 1, 2001. Who pays and the amount of subsequent payments will depend on the level of the floating rates on the remaining reset dates.

We called the interest rate swap illustrated in Table 1.7 a *fixed-for-floating* swap. It also goes by other names including a *fixed-to-floating* swap, a *fixed-against-floating* swap, and a *coupon* swap. In order to distinguish the counterparties to a fixed-for-floating swap, one is termed the *payer* and the other, the *receiver*. The paying and receiving refer to the *fixed* interest payment. Thus, BANK A is the payer of the interest swap illustrated in Table 1.7, and COMPANY B is the receiver. Sometimes, the terms *buyer* and *seller* are used to describe swap counterparties. Since these terms are not intuitively obvious, their use in the swap market is discouraged. With fixed-for-floating swaps, however, the terms refer to the *obligation to pay fixed*. Thus, a swap *buyer pays fixed* and receives the floating interest stream. A swap *seller receives fixed* and pays floating. Thus, in our illustration, BANK A is the buyer of the interest rate swap and COMPANY B is the seller.

In general, terms of OTC derivative contracts are not available in financial publications such as the *Wall Street Journal*. Indeed, since OTC derivatives are privately negotiated and have wide-ranging terms, there are no means to systematically collect and report such information. One way to obtain indicative prices or rates of certain "generic" OTC derivatives deals is to subscribe to a service such as Bloomberg, Reuters, and Telerate that provides such quotes on a real-

[39] See International Swaps and Derivatives Association (2000b, p.41).

**TABLE 1.8** Fixed-for-floating interest rate swap quotes from Bloomberg at 3:50 PM (EST) on Monday, August 7, 2000.

| Term | Bid | Ask |
|---|---|---|
| 2 yr | 6.983 | 7.024 |
| 3 yr | 6.985 | 7.026 |
| 4 yr | 7.013 | 7.053 |
| 5 yr | 7.036 | 7.077 |
| 6 yr | 7.059 | 7.100 |
| 7 yr | 7.079 | 7.120 |
| 8 yr | 7.084 | 7.125 |
| 9 yr | 7.100 | 7.141 |
| 10 yr | 7.112 | 7.153 |
| 15 yr | 7.139 | 7.180 |
| 20 yr | 7.123 | 7.164 |
| 30 yr | 7.083 | 7.123 |

time basis. Essentially, what these services provide is access to a number of pages (computer screens), each page containing the current market quotes of generic types of trades. The rates shown in Table 1.8, for example, are fixed-for-floating swap rates provided on one of Bloomberg's screens at 3:50 PM (EST) on Monday, August 7, 2000. While interest rate swaps can have a wide variety of terms, the terms of these swaps are "standardized." The periodic payments of all these swaps are made semiannually, with the first payment occurring in 6 months. All of the rates are set in such a manner that the swaps have a zero upfront payment. The floating rate interest payment is indexed to the 6-month LIBOR rate with an "actual/360" day-count fraction convention, and the fixed rate interest payment is based on the quotes appearing in the table and is calculated using a "30/360" day-count fraction convention. So, given these standard practices, the terms of the entire swap are summarized by the term and by the fixed rate. Bid and ask rates appear in the table (on the Bloomberg screen). These represent the highest bid rate and the lowest ask rate of all OTC dealers supplying Bloomberg with intraday quotes. If you buy the swap, you will pay the ask rate and receive LIBOR. If you sell the swap, you will receive the bid rate and pay LIBOR. The difference between the bid and ask rates is the dealer's spread. As the table shows, spreads in the plain-vanilla interest rate market are incredibly small, averaging about 4 basis points.

#### Currency Forwards

Currency forward prices are also reported on a real-time basis by a number of data vendors. The prices reported in Table 1.9, for example, were drawn from Bloomberg. The table contains U.S. dollar (USD) bid and ask price quotes of one Great Britain pound (GBP) in the spot and forward markets as of 2:25 PM (EST) on March 27, 2006. To buy one pound in the spot market costs USD 1.7478. To buy one pound in one week (i.e., a 1-week forward contract) costs USD 1.7479, and so on. Forward rates are quoted with terms to maturity as

**TABLE 1.9** USD/GBP spot and forward exchange rate quotes drawn from Bloomberg at 2:25 PM (EST), March 27, 2006.

| | USD/GBP | | |
|---|---|---|---|
| **Term** | **Bid Rate** | **Ask Rate** | **Bid/Ask Spread** |
| Spot | 1.7475 | 1.7478 | 0.0003 |
| 1 week | 1.7476 | 1.7479 | 0.0003 |
| 1 month | 1.7480 | 1.7483 | 0.0003 |
| 2 month | 1.7487 | 1.7490 | 0.0003 |
| 3 month | 1.7494 | 1.7497 | 0.0003 |
| 4 month | 1.7503 | 1.7506 | 0.0003 |
| 5 month | 1.7510 | 1.7514 | 0.0004 |
| 6 month | 1.7519 | 1.7522 | 0.0003 |
| 9 month | 1.7543 | 1.7547 | 0.0004 |
| 1 year | 1.7562 | 1.7567 | 0.0005 |
| 2 year | 1.7602 | 1.7615 | 0.0013 |
| 3 year | 1.7645 | 1.7688 | 0.0043 |
| 4 year | 1.7685 | 1.7763 | 0.0078 |
| 5 year | 1.7760 | 1.7853 | 0.0093 |

long as five years. Note that as the time to maturity increases, the spread between the bid and ask rates increases. This is a reflection of the fact that the markets for longer term forward contracts are less liquid.

## SUMMARY

This chapter provides a broad-ranging overview of derivative contract markets. The first lesson of the chapter is that there exist only *two* types of derivative contracts—a forward and an option. Buying a forward means that you are obliged to buy the asset specified in the contract at some future date at a price agreed upon today. Buying an option means that you have the right, but not the obligation, to buy (in the case of a call) or sell (in the case of a put) the underlying asset at some future date at a price agreed upon today. So, although current day markets appear to have different types of derivative contracts trading, do not be overwhelmed. Each and every one can be decomposed into a portfolio of forwards and options.

The second lesson is that derivatives markets exist because it is either expensive to trade the underlying asset, or trading in the underlying asset is restricted in some way. Derivative contract trading is merely an inexpensive and effective means of trading the underlying asset.

The third lesson involves developing an understanding of the evolution of derivatives markets. Derivative contracts have been around thousands of years. The first recorded use dates back to 18th century BCE in ancient Babylon. Early derivative contracts resulted from private (or "over-the-counter") negotiations,

hence trading was relatively undisciplined, and contract defaults were not uncommon. By the mid-1860s, it became clear that centralized markets with standardized contracts and a clearinghouse would add structure to the market, improving market depth and liquidity, and would eliminate the undesirable consequences of contract default. Hence, the birth of the first futures exchange—the Chicago Board of Trade in 1985. From the late 1800s through the 1960s, futures contracts written on physical commodities were the dominant form of derivatives trading. While grains were the first to be introduced, physical commodities such as metals and livestock were added during this period. In addition, many more futures exchanges were introduced in the United States as well as other countries worldwide including Canada, Brazil, the United Kingdom, and Australia.

Beginning in the early 1970s, derivatives markets have gone through some dramatic changes. The 1970s saw the introduction of exchange-traded futures on financial assets such as currencies and interest rates as well as exchange-traded options on common stocks. The 1980s saw even more interesting and important innovations in exchange-traded derivatives market—cash settlement of derivative contracts, stock index futures, and options on underlyings including currencies, interest rates, and stock indexes. The 1980s also saw the rebirth of OTC derivatives markets. The newfound interest in derivatives on financial assets, together with the OTC markets' flexibility in contract design, spawned the development of contracts tailor-made to meet the risk management needs of customers. Where the notional amount of OTC contracts was negligible in the early 1980s, it matched exchange-traded derivatives by 1991 and is nearly seven times larger today.

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## APPENDIX 1: SQUEEZING THE SOYBEAN MARKET[40]

In the spring of 1989, an Italian grain-trading firm by the name of Ferruzzi Finanziaria S.p.A. began acquiring soybean futures contracts. Simultaneously, the firm purchased a significant percentage of the cash-market soybeans available for delivery against these contracts. Whether the firm's intentions were to squeeze markets it is impossible to say. Regardless of the Ferruzzi's intentions, however, on July 12, 1989, the size of the firm's holdings compelled the Chicago Board of Traded (CBT) to order all market participants to liquidate soybean futures positions in excess of the speculative trading limit. Exchanges rarely actively interfere with markets and news of the CBT's directive made headlines worldwide. This appendix describes the events and the aftermath of the CBT's decision to take emergency action.

### Soybean Markets in the Spring of 1989

Soybean markets were in peril as early as 1988. The worst drought in nearly half a century was devastating farmers in the United States and rapidly shrinking soybean reserves. The U.S. Department of Agriculture forecast that by the end of August 1989 there would be only 125 million bushels of soybeans remaining in silos: a mere three-week supply! The scarcity of domestic reserves stood to significantly increase the probability that market participants with short positions in soybean futures markets would default. Market defaults are borne by clearinghouses and impede normal exchange activity. Consequently, the grim state of soybean markets had regulators on edge. It was apparent that soybean markets would only maintain their integrity "if all market participants conducted their business in an economic and responsible manner." Any deviation from this standard had the potential to instigate a disastrous string of events.

### A Crisis Develops

Hedgers holding long futures contracts unwind positions if and when an underlying commodity can be purchased cheaply enough on the cash market to cover costs of carry. Upon purchase of the underlying commodity, futures contracts become redundant. After all, there is no need to lock in the price of an asset already owned.

For this reason, given the current state of soybean markets, regulators grew anxious as an international grain-trading organization named Ferruzzi Finanziaria purchased soybean futures and soybean stocks simultaneously. If the company's intention was to hedge against increases in the price of soybeans (as company spokespeople claimed), this behavior was illogical. Indeed, at the same time Ferruzzi was aggressively buying soybean and soybean future contracts, the

[40] I am grateful for the help of Seth James Wechsler in preparing the first draft of this appendix. The dates and details of the emergency actions taken in response to the apparent squeeze in the soybean market were taken from Chicago Board of Trade (1990). The quotes appearing in this appendix were also taken from CBT (1990).

majority of firms hedging soybean prices were unwinding their long positions and acquiring soybeans on the cash market. If Ferruzzi continued to hold dominant positions in both the futures and cash market, regulators were concerned that prices might become artificially inflated.

### A Crisis Postponed

On May 16, with just three days remaining until the expiration date of the May futures contract, the Commodity and Futures Trading Commission delivered a written warning to Ferruzzi:

> We are further concerned by the large long position that you hold in the May future. We believe that because of your holding of about 16.2 million bushels relative to the amount of soybeans available for delivery, your further actions can have a substantial impact on whether or not the price of the May future becomes artificial relative to commercial values. You are prohibited by law from causing an artificial price. Price manipulation is a violation of . . . . the Commodity Exchange Act.[41]

and

> if prices of the May future have been, are now, or should become artificial during the liquidation due to your action or inaction, we will consider whether or not to pursue an investigation that could result in charges of price manipulation.[42]

As of May 18, however, Ferruzzi still had not liquidated its position. At this point, the CTFC took a more aggressive approach. Ferruzzi Finanziaria was contacted by phone and informed that its hedging exemptions were revoked.[43]

Ferruzzi responded by engaging in a number of spread transactions. More specifically, it sold its May futures contracts and bought July. Markets would maintain their integrity in May, but the stage was set for a fierce, potentially disruptive confrontation in July.

### A Tightening Fist—Ferruzzi Increases Size of its Holdings

By early June Ferruzzi had acquired a 32-million-bushel net long position in the July futures contract. This position was almost double the size of the long position the firm had been ordered to unwind only three weeks earlier! When asked to explain the size of its position, Ferruzzi claimed that its futures holdings were

[41] CBT (1990, p. 20).
[42] CBT (1990, p. 9).
[43] A hedging exemption permits a firm to hold contracts in excess of the speculative trading limit. In the case of soybeans, the speculative trading limit is 3 million bushels. Firms are granted hedging exemptions routinely, however exchanges can revoke these exemptions at any time should it be judged that the exemptions are being used for speculative purposes.

hedges against export sales and the anticipated crushing requirements of Central Soya, a major U.S. soybean processor and wholly owned subsidiary of Ferruzzi Finanziaria. Because the expiration date of Ferruzzi's contracts was two months away, regulators deemed immediate action to be unnecessary. Ferruzzi Finanziaria's holdings would be closely monitored and action would be taken (if necessary), as the firm's contracts reached maturity.

Would Ferruzzi actually purchase the soybean requirements it claimed to be hedging? If and when the soybeans were acquired, would Ferruzzi proceed with an orderly liquidation of its long futures positions? Only time would tell.

### Crisis and Confrontation

As July approached, Ferruzzi remained virtually the sole holder of soybean stocks in approved-for-delivery locations. Assuming Ferruzzi intended to refrain from price manipulation, this behavior was highly irregular. To appreciate this, one must examine the differences between futures prices expiring in July and in August. At the end of May, the July futures contract was priced 7 cents higher than the August contract. By June, this differential had climbed to 30 cents. As June drew to a close, the difference was 40 cents! Despite the enormous profits it could have reaped by selling its futures contracts, Ferruzzi chose to maintain its prodigious long position. Additionally, Ferruzzi failed to liquidate futures contracts at critical times when soybeans could have been purchased for lower net costs than those resulting from soybean delivery via the July futures. Taking into account expenses associated with load-out, weighing and grading, transportation, and allowance for grade difference, local soybean prices were substantially below the cost of acquiring soybeans via the futures-delivery mechanism.

The size of Ferruzzi's holdings measured on a per bushel basis decreased as the end of July approached, but Ferruzzi's holdings in terms of the percentage of the contract's open interest increased drastically. As of June, the firm owned 18% of the contract's open interest. By the second week in July, Ferruzzi owned 53% of the contract's open interest!

As July 19 drew near, regulators felt that Ferruzzi had disregarded normal hedging practices to such a large extent that interference in markets was once again necessary. If the CBT or the CFTC did not intervene, a price distortion, and the market failures that could accompany it, would be nearly unavoidable.

Both the CBT and the CFTC had been in almost daily contact with Ferruzzi since May:

> June 1: CFTC staff urges Ferruzzi to buy cash and liquidate July futures.
>
> June 5: CBT's Business Conduct Committee calls in all major market participants, long and short, and reminds them of their obligation to effect orderly liquidation of the next expiring contract.
>
> June 12: CFTC staff urges Ferruzzi to buy cash and liquidate futures.

> June 13 and June 14: CFTC staff again urges Ferruzzi to buy cash and liquidate futures.
>
> June 15: Senior staffs of CBT and CFTC meet in Chicago to discuss concerns about orderly liquidation of July futures.
>
> June 19 and 28: CFTC staff once more urges Ferruzzi to buy cash and sell futures.

By July it had become apparent that Ferrruzzi would not liquidate its contracts unless forced to do so. On July 5, the CBT's Business Conduct Committee summoned representatives of Ferruzzi Finanziaria. These representatives were informed that unless immediate steps were taken to liquidate July futures contracts the CBT's Board of Directors would be asked to consider emergency action. The CFTC relayed a similar message to Ferruzzi representatives on July 6. On July 7, the CBT's Business Conduct Committee delivered a final warning. Continued failure to comply by July 10, Ferruzzi was warned, would almost certainly result in emergency action by the exchange.

Despite these warnings, however, Ferruzzi representatives made it quite clear that the company had no intention of reducing its holdings.

### Emergency Action

Upon concluding that Ferruzzi had little intention of complying with federal and exchange regulations the CFTC's reaction was immediate. On July 11, Ferruzzi's hedging exemptions were revoked. The chairman of the CBT's Board of Directors was notified that emergency action in soybean markets might be necessary.

The Board of Directors met immediately following the close of trading on July 11. Information concerning Ferruzzi's holdings was presented to the committee and the consequences of emergency action were discussed. The board adopted the following Emergency Resolution by a vote of 16 to 1:

> RESOLVED, that the Board of Directors of the Board of Trade of the City of Chicago hereby determines that an emergency exists with regard to the July 1989 soybean futures contract traded on the exchange that requires immediate action and threatens or may threaten fair and orderly trading in, the liquidation of, and delivery pursuant to, the July 1989 soybean futures contract, and hereby adopts the following measure to deal with this emergency.
>
> Effective as of the opening of the market on July 12, 1989, any person or entity either alone or in conjunction with any other person or entity, who owns or controls a gross long or short position for any purpose whatsoever in excess of three million bushels in the July 1989 soybean futures contract traded on the Exchange must reduce said position and subsequent positions by at least 20% per trading day subject to the following absolute limits . . .

> [The limits precluded any person from owning or controlling a July 1989 soybean futures position of more than 3 million bushels on July 18 or more than 1 million bushels as of the expiration of trading on July 20][44]

### The Aftermath—Soybean Market Stability Ensured

Overall, financial institutions were supportive of the CBT's intervention in soybean markets. There were critiques of the action, however. Critics contended that Ferruzzi's liquidation triggered an artificially large decline in futures prices.

July futures prices did decline following the CBT's announcement that emergency action was to be taken. On the first day of Ferruzzi's mandated liquidation, futures prices closed 39.5 cents a bushel lower than at the opening bell. As Ferruzzi continued to carry out its liquidation, however, soybean prices actually rose. In fact, by the time Ferruzzi had completed unwinding its holdings, futures prices were actually 1.5 cents higher than they had been at the start of the liquidation. An appraisal of the effects of the emergency action conducted by an independent government agency later confirmed that the CBT's intervention had "no significant effect" on either farm or consumer soybean prices.

As for Ferruzzi Finanziaria, the firm underwent a major reorganization of its international trading operations. On September 15, 1989, Ferruzzi announced that its three principal grain and oilseed traders had resigned because of "differences over trading."

[44] CBT (1990, p. 20).