CHAPTER 6

Currency Futures and Options

Opening Case 6: Derivatives Risks

Do you know how many days it took for a son to lose $150 million in foreign-exchange trading that it had taken his father decades to accumulate? The answer is just 60 days. The following story illustrates how volatile the currency derivatives market was in the 1990s.

"Dad, I lost a lot of money," Zahid Ashraf, a 44-year-old from the United Arab Emirates, confessed to his ailing father, Mohammad. "Maybe no matter," the father said, recalling the conversation in court testimony. Mohammad Ashraf, who had built one of the largest gold and silver trading businesses in the Persian Gulf, then asked, "How much have you lost?" The answer – about $150 million – mattered plenty to the stunned 69-year-old family patriarch.

In 2 months of foreign-currency trading in 1996, Zahid wasted much of a fortune ($250 million) that it had taken his father decades to build. The tight-knit Ashraf family estimates that Chicago-based commodities giant Refco Inc. collected about $11 million in commissions for the trades. So they sued Refco for $75 million of their losses. The Ashrafs contended that "Refco brokers conspired Zahid Ashraf to execute massive unauthorized speculative trading in currency futures and options" and "to conceal these trades from other family members." However, after a seven-day trial in February 1999, the jury ruled against the Ashrafs, not only rejecting their claim, but also finding that the family's Eastern Trading Co. still owed Refco $14 million on Zahid's uncovered losses. Because it involved a family business whose home turf is far from the world's financial capitals, such as New York or London, the debacle transpired virtually unnoticed. But it serves as yet another reminder of hazards posed by the volatile derivatives markets of the 1990s.

Financial derivatives, such as futures, options, and swaps, are supposedly hedging instruments designed to alleviate or eliminate a variety of risks. These hedging instruments are generally considered safe for short-term purposes, but they are not risk free either. Even some reputable companies, such as Procter & Gamble, have incurred large derivative-related losses in recent years (see Case Problem 7: Regulation of Derivatives Markets). Such corporate disasters related to financial derivatives continue to be a problem in global business. As is the case with so many issues in modern society, technology is not at fault, but rather human error in its use.

Sources: "How Currency Trading Run Amok Crushed a Family," *The Wall Street Journal*, Apr. 8, 1999, pp. C1, C13; and M. H. Moffett, A. I. Stonehill, and D. K. Eiteman, *Fundamentals of Multinational Finance*, Boston, MA: Addison-Wesley, 2003, p. 157.

Multinational companies (MNCs) normally use the spot and forward markets for international transactions. They also use currency futures, currency options, and currency futures options for various corporate functions. While speculators trade currencies in these three markets for profit, MNCs use them to cover open positions in foreign currencies.

This chapter is divided into three closely related sections. The first section discusses currency futures. With a **currency futures contract**, one buys or sells a specific foreign currency for delivery at a designated price in the future. The second section describes currency options. A **currency option** is the right to buy or sell a foreign currency at a specified price through a specified date. The third section examines currency futures options. A **currency futures option** is the right to buy or sell a futures contract of a foreign currency at any time for a specified period.

Global Finance in Action 6.1

More Bang for Your Buck in Currency Trading

The potential of CME foreign-currency futures and options on futures is easy to understand.

They are volatile. They offer low margins. And they are exceptionally liquid, with an average daily volume close to 100,000 contracts.

Most important, CME currency contracts trend well, year after year. And they respond to familiar, fundamental economic factors – the kind of information you follow every day in the news.

What is more, with CME foreign-currency options, you can take advantage of opportunities in the market with limited risk.

Of course, trading foreign-currency futures and options at the CME does involve risk. But if you can afford to assume it, they offer everything a speculator could want.

More bang for the buck. The euro. And the yen. To learn more, call your futures broker.

Source: Chicago Mercantile Exchange (CME).

6.1 The Currency Futures Market

The Chicago Mercantile Exchange (CME), known as "The Merc," was founded in 1919 as a nonprofit organization to trade spot and futures commodity contracts. In 1972, the CME introduced futures trading in foreign currencies through the International Monetary Market (IMM) as an alternative to regular forward contracts offered by commercial banks. Most major exchanges around the world have added currency futures in recent years. They include the Philadelphia Board of Trade, the New York Board of Trade, the Deutsche Termin Borse in Frankfurt, the Hong Kong Futures Exchange, the London International Financial Futures Exchange, the New Zealand Futures Exchange, the Singapore International Monetary Exchange, the Stockholm Options Market, the Tokyo International Financial Futures Exchange, the Mer Der Exchange in Mexico, the BM&F Exchange in Brazil, the Budapest Commodity Exchange, and the Korean Futures Exchange.

6.1.1 Futures market participants

Futures contracts are deals made now to take place in the future. In a futures contract, the buyer and the seller agree on:

1 A future delivery date.
2 The price to be paid on that future date.
3 The quantity of the currency.

The currency futures market was created for those who use foreign exchange in business. Businesses, which deal with international transactions, routinely buy and sell foreign exchange in the spot market. They enter the futures market only to protect themselves against risks from volatile exchange rates. The currency futures contract is like an insurance policy against changes in exchange rates. In practice, most currency futures contracts are nullified by opposing trades, so futures traders rarely take delivery of a foreign currency; in fact, nearly 98 percent of them are terminated before delivery.

There are two distinct classes of traders in the currency futures market: hedgers and speculators. **Hedgers** buy and sell currency futures contracts to protect the home currency value of foreign currency denominated assets and liabilities. They include MNCs, importers, exporters, bankers, and brokers, who require protection against adverse exchange rate movements. They expect their profits to come from managerial skills in conducting their business activities, not from incidental fluctuations in exchange rates. **Speculators**, on the other hand, buy and sell currency futures contracts for profit from exchange rate movements. They trade futures strictly for profit; they can make or lose fortunes. A speculator trades currency futures but never uses the currency.

A hedger may place a contract with another hedger who wishes to cover currency needs in the opposite direction, but the other party to the contract typically is a speculator. Though criticized for greed, speculators play a vital role in futures markets by assuming the risk of the hedger. Their presence not only gives the market liquidity and continuity but also eases entry and exit.

Currency futures trading can take place for hedging or speculation, as well as for arbitrage. In particular, some traders quickly take advantage of any profitable differential, for the same

Table 6.1 Currencies traded on the Chicago Mercantile Exchange

Currency	*Contract size*
Australian dollar	A$100,000
Brazilian real	R100,000
British pound	£62,500
Canadian dollar	Can$100,000
Euro	€125,000
Japanese yen	¥12,500,000
Mexican peso	Mex$500,000
New Zealand dollar	NZ$100,000
Russian ruble	RR500,000
South African rand	R500,000
Swiss franc	SFr125,000
Cross rate futures (underlying currency/price currency)	
Euro/British pound	125,000
Euro/Japanese yen	125,000
Euro/Swiss franc	125,000

currency, between rates quoted in different markets, such as the spot market, the futures market, and the forward market.

6.1.2 *The futures market and the forward market*

Futures contracts are normally available in a predetermined amount and for one of several specified maturity dates. As table 6.1 shows, futures contracts are currently available for 11 currencies with contract sizes specified by the CME. Futures contracts mature on only 4 days of the year; the maturity dates occur on the third Wednesday of March, June, September, and December.

While the principle of protection against currency price fluctuations is the same in the futures and forward markets, there are two major differences. First, the forward market offers contracts for specific amounts of currencies tailored to particular needs, while the futures market offers only standardized contracts in the predetermined amounts. Take, for example, an importer who wishes to cover accounts payable of Can$140,000. He could cover only a portion of the risk in the futures market, but could arrange for full coverage with a single contract in the forward market. Second, a forward contract can cover the exact date the foreign currency is needed, but the futures contract has a standardized delivery date. Suppose an MNC wishes to lift its hedge before the expiration date of the futures contract. It must assume some risk of a currency price fluctuation between the settlement date of the transaction and the delivery date of the contract.

Because MNCs have specialized needs, they normally prefer the forward contract. Consider IBM, which on April 20 realizes it will need Can$240,000 on May 20 (30 days later). If IBM tries to lock in the future purchase price of Canadian dollars with a futures contract, the closest contract settlement date is the third Wednesday of June. Also, the amount of Canadian dollars

needed (Can$240,000) is more than the standardized amount (Can$100,000) specified in the contract. The best IBM can do is to buy two futures contracts (Can$200,000), but the forward market can be tailored to meet the individual needs of MNCs. IBM can buy a forward contract of Can$240,000 with a maturity date of 30 days from BankAmerica.

Currency futures contracts and forward contracts are acquired for hedging, speculation, or arbitrage. Yet, the futures market is more centralized, standardized, and less customer-oriented than the forward market. The futures market and the forward market differ in notable ways:

1 *Price range*. Because the CME specifies a maximum daily price range for each day, a futures market participant is not exposed to more than a limited amount of daily price change. But forward contracts have no daily limits on price fluctuations.
2 *Maturity*. CME futures contracts are available for delivery on one of only four maturity dates per year, but banks offer forward contracts for delivery on any date.
3 *Size of contract*. The futures market offers only standardized contracts in predetermined amounts, but the forward market offers contracts for specific amounts of currencies tailored to specific needs.
4 *Regulation*. The futures market is regulated by the Commodity Futures Commission, but the forward market is self-regulating.
5 *Settlement*. Less than 2 percent of the CME futures contracts are settled by actual delivery, but more than 90 percent of forward contracts are settled by delivery.
6 *Location*. Futures trading takes place on organized exchanges, but forward trading is negotiated directly between banks and their clients.
7 *Credit risk*. The CME guarantees to deliver the currency on schedule if the seller defaults, or to acquire it if the buyer defaults. On the other hand, a bank dealing in the forward market must satisfy itself that the party with whom it has a contract is creditworthy.
8 *Speculation*. CME brokers accommodate speculative transactions, whereas banks generally discourage speculation by individuals.
9 *Collateral*. A security deposit (margin) must back every futures contract, but forward contracts do not require any margin payment. Compensating balances are required in most forward contracts.
10 *Commission*. In the futures market, commissions of intermediaries depend on published brokerage fees and negotiated rates on block trades. In the forward market, a "spread" between the bank's buy and sell prices sets the commissions of intermediaries.
11 *Trading*. Futures contracts are traded in a competitive arena, but forward contracts are traded by telephone or telex.

6.1.3 How to read currency futures quotes

The Wall Street Journal and other major newspapers carry currency futures quotations, though they do not list the newest or least active contracts. To explain how to read currency futures quotes, we will focus on the Australian dollar futures traded on the CME. Table 6.2 presents the Australian dollar futures prices reported in *The Wall Street Journal* on July 1, 2004. Because there is a one-day time lag between the transactions of foreign exchange and the report of these transactions, we obtained the June 30 quotations from the July 1 issue of *The Wall Street Journal*.

The top, bold-faced line gives the name of the currency, in this case the Australian dollar (AUD); the exchange on which it is traded according to a key in the table, such as the

Table 6.2 Currency futures quotations in the CME: the Australian dollar

						Lifetime		
	Open	*High*	*Low*	*Settle*	*Change*	*High*	*Low*	*Open interest*
AUSTRALIAN DOLLAR (CME) – AUD 100,000; $ per AUD								
Sept.	.6857	.6917	.6821	.6910	.0070	.7780	.5756	25,951
Dec.	.6782	.6832	.6780	.6852	.0070	.7705	.6150	132
Est. vol. 3,997 vol. Tue 8,258; open int. 26,312, +1,335								

Source: *The Wall Street Journal*, July 1, 2004, p. C18.

CME; the size of a single contract, such as AUD100,000 per contract; and the way in which prices are quoted, such as dollars ($) per AUD. The first column gives the months for which delivery of the currency may be obtained. Currency trading takes place in March, June, September, and December. The second column gives the opening price of the day. The next three columns tell us the contract's highest, lowest, and closing (settlement) prices for the day. These figures, viewed together, show how volatile the market was during the trading day. A broker uses settlement prices to evaluate portfolios or for deciding whether to call for more margin. Currency futures losses must be settled every day, and profits are credited daily to customer accounts.

The sixth column from the left of the quotation, labeled "change," shows the difference between the latest settlement price and the one for the previous day. A plus (+) sign indicates that prices ended higher; a minus (–) sign indicates that prices ended lower. The next two columns, the second and third from the right of the quotation, show the highest and lowest prices at which each contract has ever traded. The difference between the highest and lowest prices of each currency during its lifetime is called the "range." The range represents the volatility of the currency or the dispersion of individual prices for the currency around its average price. The wider the dispersion, the higher is the risk. If the highest price and the lowest price are not widely separated from their neighboring prices, the range may be a good measure of risk. If these two prices are erratic, the range should not be used as a measure of risk, because it is unreliable and misleading.

The right-hand column, labeled "Open interest," refers to the total number of outstanding contracts; that is, those that have not been canceled by offsetting trades. This column allows us to see how much interest there is in trading a particular contract. The closest months usually attract the most activity, as we can see from the difference between the June mark contracts and the September mark contracts.

A line at the bottom of each currency quotation gives the estimated number of contracts for the day (Tuesday, June 30), the actual trading volume for the preceding day (Monday, June 29), the total open interest, and the change in the open interest since the preceding day. In other words, "Est. vol.," "vol. Tue," and "open int." are total figures for all the months combined for the trading day.

6.1.4 Market operations

An agreement to buy a futures contract is a **long position** and an agreement to sell a futures contract is a **short position**. To trade futures, people give their broker an order to enter them

into a contract as either a buyer (the long position) or as a seller (the short position), depending on which way they think the market is heading.

MARGIN REQUIREMENTS Some form of deposit ensures that each party fulfills its commitment; this type of deposit is called the margin. The exchanges set a minimum margin for each contract, but brokers often require larger margins from clients. The amount of a futures margin depends on the volatility of the contract value and hence on the risk. Margin levels also vary for hedging and speculating accounts. For example, exchanges and brokerage firms normally require lower margins for hedging accounts because they carry less risk than speculating accounts.

The two basic types of margins are required: the initial margin and the maintenance margin. The **initial margin** is the amount market participants must deposit into their margin account at the time they enter into a futures contract. Then, on a daily basis, the margin account is debited or credited to protect buyers and sellers against the possibility of contract default. Initial margins for futures contracts typically range between 1 and 4 percent of a contract's face value and are set by the exchanges where the contracts are traded.

The **maintenance margin** is a set minimum margin customers must always maintain in their account. On any day that market losses reduce funds in the account below the maintenance margin, the broker calls on his customer for an additional deposit to restore the account to the initial margin level. Requests for additional money are known as **margin calls**. The maintenance margin is usually 75 percent of the initial margin.

In addition to these two basic types of margins, market participants are required to post **performance bond margins**, which are financial guarantees imposed on both buyers and sellers to ensure that they fulfill the obligation of the futures contract. In other words, they are required to make or take delivery of the futures contract unless their position is offset before the expiration of the contract. The purpose of a performance bond margin is to provide integrity.

Example 6.1

Lisa George buys Australian dollar futures contracts to cover possible exchange losses on her import orders denominated in Australian dollars. She has to put up an initial margin of $3,000. The maintenance margin imposed by the exchange is 75 percent of the initial margin, or $2,250. When would she get a margin call from her broker?

If the spot rate for Australian dollars declines, the value of Ms George's position declines. As long as the decline is less than $750, Lisa George does not need to put up any additional margin. Yet, if the cumulative decline in value comes to $751, her margin account would stand at $2,249. She would get a margin call from her brokerage firm and must restore the account to the initial level of $3,000. Otherwise, the exchange will sell out her position and return any remaining balance in her account.

SPECULATION IN THE FUTURES MARKET Speculation offers potentially large profits or losses due to the highly leveraged nature of futures trading. Because margin requirements average less than 4 percent of the contract's full value, it is possible to control large amounts of currencies with little capital. Speculators deliberately expose themselves to exchange risk by engaging in futures contracts in order to make profits from exchange rate movements.

Example 6.2

Kenneth Lee, a speculator, enters into a futures contract for March delivery of SFr125,000 on February 1. The futures exchange rate of the Swiss franc for March delivery (March 15) is $0.5939 per franc. The margin requirement is 2 percent. His expectation of the spot rate for francs on March 15 is $0.6117. If his expectation proves correct, what would be his rate of return on investment?

Because the margin requirement is 2 percent, Mr Lee may control this delivery of SFr125,000 for $1,484.75 (SFr125,000 × $0.5939 × 0.02). He could buy SFr125,000 futures for $74,237.50 at the futures quotation of $0.5939, receive them on March 15, and then sell them at the spot rate of $0.6117 for a gross of $76,462.50. Profit would be $2,225. So, he would earn a net profit of $2,225, or 150 percent on the original investment of $1,484.75. Here, the exchange rate would rise by only 3 percent [(0.6117 – 0.5939)/0.5939], but the rate of return on investment would be 150 percent. Yet the same leverage could lead to equally substantial losses. If the spot rate were to decline by 3 percent during this period, Mr Lee would lose about 150 percent of his investment.

HEDGING IN THE FUTURES MARKET A single forward contract can arrange for the precise amount and maturity that the bank's customer desires. A single futures contract is available only in a predetermined amount for one of the four maturity dates each year. These two features of the futures market may force MNCs to assume some risks of coverage and of currency fluctuation, because they usually need a specified amount of a currency on a specified date. Still, these risks can be minimized in a properly structured hedge. Prices in the spot and futures markets move in the same direction by similar amounts due to arbitrage transactions between these two markets.

Example 6.3

On February 1, an American firm imports 5,000 Swiss watches at a cost of SFr250,000 with payment and delivery due on March 1. The Swiss firm, being a tough negotiator, has demanded that the payment be made in Swiss francs upon the delivery of the watches. The exchange rates are $0.6667 per franc in the spot market and $0.6655 per franc in the futures market for delivery on March 15.

Table 6.3 Buying two franc futures contracts on February 1

	Spot market	*Futures market for March 15 delivery*
Exchange rate	$0.6667/SFr	$0.6655/SFr
Cost of SFr250,000	$166,675	$166,375
Action taken	None	Buy two March 15 contracts

Table 6.4 Reversing the earlier futures contracts on March 1

	Spot market	*Futures market for March 15 delivery*
Exchange rate	$0.7658/SFr	$0.7650/SFr
Cost of SFr250,000	$191,450	$191,250
Action taken	Buy SFr250,000	Sell two March 15 contracts

Given the costs of marketing the watches, the importer decides that the futures exchange rate is low enough for the company to purchase them and make a profit on the transaction. However, the importer must pay for the watches on March 1, although the expiration date of the futures contract is March 15. The importer can hedge most of its exposure by buying March Swiss franc contracts on February 1, with the intention of lifting the hedge on March 1. Because franc contracts are available from the CME in units of 125,000, the importer would purchase two March contracts, as shown in table 6.3.

The importer could trade out of the contracts by selling them before receiving a delivery notice on March 15. The only risk that the company still faces comes from the difference in the value of the contract on March 1 and its value on March 15. Assume that by March 1 the following two things would happen: (1) the spot rate would appreciate to $0.7658 and (2) the futures rate would rise to $0.7650. The importer could close out the franc futures contracts by selling them on March 1, as shown in table 6.4.

On March 1, the importer purchases SFr250,000 in the spot market for $191,450 and settles its import bill. However, this $191,450 is higher ($24,775) than its original value on February 1 ($166,675); in other words, the exchange loss from the spot transaction is $24,775. The futures contract that the company sold on March 1 ($191,250) is higher ($24,875) than the $166,375 the company anticipated in the futures contract that it purchased on February 1; in other words, the exchange gain from the futures transaction is $24,875. The $24,875 gain from the futures transaction exceeds the $24,775 loss from the spot transaction. The risk that the importer assumed on February 1 by purchasing two contracts whose maturity did not coincide with the March 1 usage date of the currency resulted in a windfall exchange gain of $100 ($24,875 – $24,775). This $100 gain arose from the difference between the spot rate and the futures rate prevailing on the day the contracts were liquidated. This difference is the "basis."

The basis, unlike the spot rate itself, is relatively stable and narrows toward zero as the contract moves toward maturity. For example, the basis on February 1 was $0.0012 per

franc ($0.6667 – $0.6655), while by March 1 it had shrunk to $0.0008 ($0.7658 – $0.7650). The degree of uncertainty about the futures price diminishes further as the contract approaches its March 15 expiration date. On March 15, the futures rate, in effect, becomes the spot rate.

In example 6.3, the difference of $0.0004/SFr in the basis between February 1 and March 1 accounted for the windfall exchange gain of $100. This gain might easily have been an exchange loss of a similar amount if the exchange rate of the Swiss franc had depreciated during the same period. The important point is that the importer was protected from any major loss regardless of exchange rate movements. For example, if the importer had not purchased the futures contract and had bought SFr250,000 in the spot market on March 1, the watches would have cost an additional $24,775.

Frequent futures traders may try to coordinate trading between two different markets or two different currencies through a strategy called **spread trading**, which means buying one contract and simultaneously selling another contract. They will always make money on one contract and lose money on the other contract. Thus, they may make or lose more money on the one contract than they lose or make on the other, but they are protected from major loss regardless of exchange rate movements.

THE TRADING VOLUME IN CURRENCY FUTURES The currency futures market is a good source of funds for multinational companies, but it is relatively small and inflexible. In spite of its drawbacks, the futures market grew rapidly until 1992, with total volume falling from that high in recent years. As shown in figure 6.1, the number of currency futures contracts traded on the CME increased from only 199,920 in 1975 to 38 million in 1992. Since 1992, volume has trended downward and was cut almost in half by 2001, when only 20 million contracts were traded. This downward trend took place for at least two major reasons. First, the progress toward European Union and the growing importance of the euro have made trading in most European currencies obsolete. Second, the decline in importance of foreign-currency futures is a consequence of the continuing growth of the over-the-counter market. In the 1990s, the swap market grew to an enormous size and now dwarfs the futures market in general and the currency futures market in particular. Figure 6.2 shows the currency composition of currency futures and their market share in 2001. According to the figure, the euro has emerged as the second most important currency in terms of trading volume, accounting for 28 percent of the total market in 2001.

6.2 The Currency Options Market

Founded in 1790, the Philadelphia Stock Exchange, the oldest securities market in the United States, started currency options trading in 1983; since then, the Chicago Mercantile Exchange and the Chicago Board Options Exchange have added currency options trading. Currency options are now traded on exchanges throughout the world, including those in the USA, London, Amsterdam, Hong Kong, Singapore, Sydney, Vancouver, and Montreal.

As shown in table 6.5, currency options are currently available in six currencies at the Philadelphia Exchange: the Australian dollar, the British pound, the Canadian dollar, the euro, the

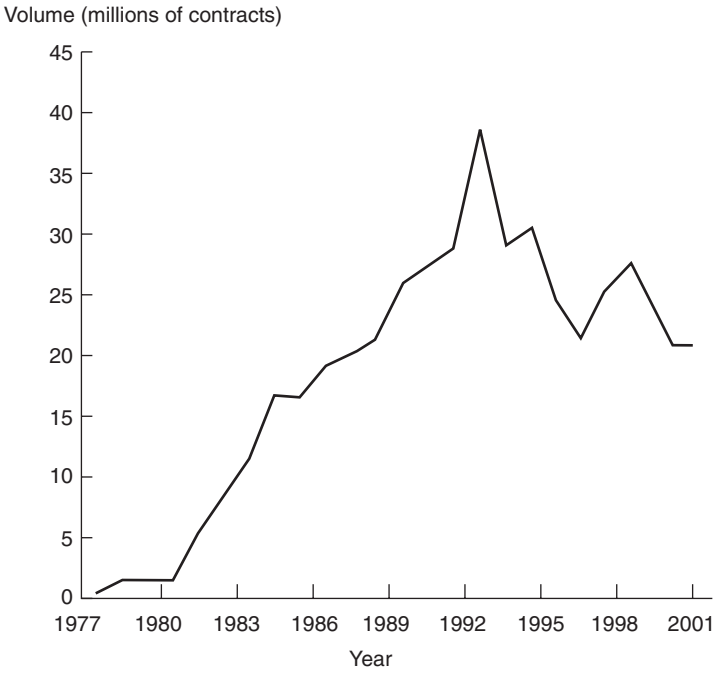

Figure 6.1 The number of currency futures contracts traded on the Chicago Mercantile Exchange
Source: The Currency Futures Trading Commission, *Annual Report*, various issues.

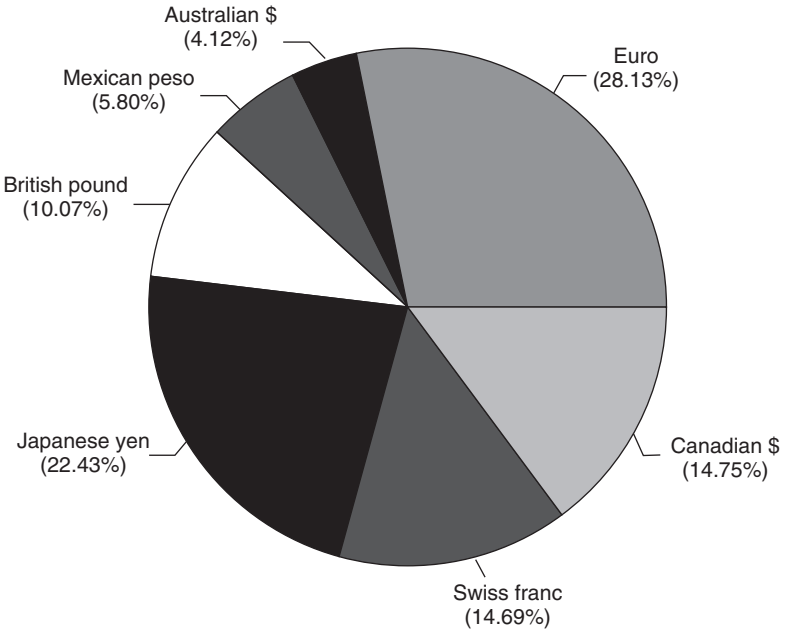

Figure 6.2 The market share for currency futures, 2001
Source: The Currency Futures Trading Commission, *Annual Report*, various issues.

Table 6.5 Currency options prices traded on the Philadelphia Exchange

Currency	*Contract size*
Australian dollar	A$50,000
British pound	£31,250
Canadian dollar	Can$50,000
Euro	€62,500
Japanese yen	¥6,250,000
Swiss franc	SFr62,500

Japanese yen, and the Swiss franc. These currency options are traded in standard contracts half the size of the CME futures contracts. For example, the pound option contract represents 31,250 units, which is half of the 62,500 units represented by the pound futures contract. In addition, a significant amount of currency options is traded outside the organized exchanges. Many banks and other financial institutions have just begun to offer currency options that have exercise prices and exercise dates to meet the specific needs of their corporate clients.

6.2.1 Basic terms

Currency options give the holder the right to buy or sell a foreign currency at a set price on or before a specified date. There are two types of options: calls and puts. A **currency call option** gives the buyer the right, but not the obligation, to buy a particular foreign currency at a specified price at any time during the life of the option. A **currency put option** gives the buyer the right, but not the obligation, to sell a particular foreign currency at a specified price at any time during the life of the option. The grantor of an option – the writer – must deliver the currency if a holder calls, or he must buy it if it is put to him by a put holder. For this obligation, the writer receives a fee or premium.

The holder of a call option will benefit if the underlying currency's price rises, while the holder of a put option will benefit if it falls. If the currency's price does not change much during the life of the option, the holder of the option loses his entire investment. For this reason, options are risky, but there is a potential for large profits in options. To buy a foreign currency outright in the spot market, an investor must pay the entire purchase price of the currency, but the price of an option is a small fraction of the price of the underlying currency.

The **strike price**, or the exercise price, is the price at which the buyer of an option has the right to buy or sell an underlying currency. Option buyers can decide whether or not to go through with the deal at any time up until the expiration date. Options pay no interest and become worthless at expiration unless the price of the underlying currency changes. Only certain expiration dates are available: the exchange, which lists the option, chooses these expiration dates.

Options differ from all other types of financial instruments in the profit–loss patterns that they produce. The beauty of options is that the holder of an option has the possibility of unlimited profit, but his maximum loss would be limited to the amount of premium paid. The holder has the choice of exercising the option or allowing it to expire unused. The holder will exercise the option only when it becomes profitable. On the down side, the holder can let the option

Table 6.6 Swiss franc option quotations

Option & underlying	*Strike price*	*Calls – last*			*Puts – last*		
		Aug.	*Sept.*	*Dec.*	*Aug.*	*Sept.*	*Dec.*
58.51	56.5	–	–	–	0.0	0.03	1.16
58.51	58	0.71	1.05	1.28	0.27	0.81	1.18
58.51	59.5	0.15	0.40	–	2.32	–	–

expire and walk away with a loss no more than the premium paid for it. On the other hand, the possibility of unlimited profit or loss exists in the spot market, the forward market, and the futures market. The profit structures for long and short positions in both the forward market and the futures market exactly mirror each other. In other words, the long or short position on an underlying currency produces a one-to-one gain or loss depending on where the spot rate ends up relative to the contracted futures rate. The buyer of a futures contract earns one dollar for every dollar the seller of the futures contract loses, and vice versa.

6.2.2 How to read currency option quotes

To explain how to read currency option quotes, we will focus on the Swiss franc option traded on the Philadelphia Stock Exchange. Table 6.6 reflects typical quotes in *The Wall Street Journal* for options on the Swiss franc. Although the table does not show them, there are two sets of figures for each of most currencies. One set consists of quotes for European-style options and another set of quotes for American-style options. A European-style option can be exercised only at the time of expiration. An American-style option can be exercised at any time between the date the option is written and its maturity date. Because American-style options are more flexible than European-style options, American-style options are typically more valuable than European-style options for a given strike price, exchange rate volatility, and period to maturity. There are also a number of cross rate options contracts available for several sets of two currencies, such as Euro–Japanese yen.

The first column shows the spot rate of the underlying currency. In table 6.6, "Option & underlying" means that 58.51 cents, or $0.5851, was the spot dollar price of one Swiss franc at the close of trading on the preceding day. The second column shows various strike prices, prices of the underlying currency at which options confer the right to buy or sell. There are several different strike prices listed for the Swiss franc, which means that there were several options available for the Swiss franc.

Then follow two groups of three figures. The first group gives the closing prices or premiums for call options at a given strike price valid until each maturity date (Aug., Sept., and Dec.). The second group gives the closing prices or premiums for put options at a given strike price valid until each maturity date (Aug., Sept., and Dec.). Options mature on the Saturday before the third Wednesday of the expiration month.

Generally, prices are highest for call options whose strike price is below the spot rate and for put options whose strike price is above the spot rate. The volume of options trading is frequently

Table 6.7 Option: in the money, out of the money, or at the money?

	Call option	*Put option*
In the money	Spot > strike	Spot < strike
At the money	Spot = strike	Spot = strike
Out of the money	Spot < strike	Spot > strike

large relative to trading in the underlying currency. This reflects trading by professionals who make their money on numerous but short-term transactions and by holders of foreign exchange who hedge large blocks with options. Such hedging provides a price protection similar to that offered by currency futures.

6.2.3 *Currency option premiums*

An option that would be profitable to exercise at the current spot rate is said to be **in the money**. An option that would not be profitable to exercise at the current spot rate is said to be **out of the money**. When the strike price of any call or put option equals the current spot rate, the option is said to be "**at the money**." Table 6.7 should help you determine whether any call option or put option is in the money, out of the money, or at the money.

A **currency option premium** is the price of either a call or a put that the option buyer must pay the option seller (option writer). This premium depends on market conditions, such as supply, demand, and other economic variables. Regardless of how much the market swings, the most an option buyer can lose is the option premium. He deposits the premium with his broker, and the money goes to the option seller. Option buyers are not required to maintain margin (deposit) accounts because of this limited and known risk.

Option sellers, on the other hand, face risks similar to those of participants in the spot or futures markets. For example, because the seller of a call option is assigned a short position, the risk is the same as for someone who initially bought a foreign currency. The option seller posts margin to demonstrate his or her ability to meet any potential contractual obligations.

Even though the marketplace is the ultimate determinant of an option premium, there are some basic guidelines that traders use to calculate option premiums. In general, an option premium is the sum of intrinsic value and time value:

$$\text{total value (premium)} = \text{intrinsic value} + \text{time value} \tag{6.1}$$

However, it is important to note that both intrinsic value and time value are influenced by the volatility of the difference between a strike price and the price of the underlying currency.

INTRINSIC VALUE **Intrinsic value** is the difference between the current exchange rate of the underlying currency and the strike price of a currency option. In other words, intrinsic value equals the immediate exercise value of the option, but it cannot be lower than zero, because

investors can let their option expire unexercised in case of a possible loss. As a result, any option with an intrinsic value is said to be "in the money." As an example, consider a put option with a strike price of $1.70 per pound and a current spot rate of $1.50 per pound. The intrinsic value of this put is $0.20 ($1.70 − $1.50) in the money, because the immediate exercise of the put would give a $0.20 cash inflow.

TIME VALUE The second major component of an option premium is the **time value**, which is the amount of money that options buyers are willing to pay for an option in the anticipation that over time a change in the underlying spot rate will cause the option to increase in value. In general, the longer the length of time before the settlement date, the higher is the option premium. This is because the right to buy or sell something is more valuable to a market participant if you have 4 months to decide what to do with the option rather than just 1 month. For example, an expiration date in June has four additional months beyond February for the spot rate to change above or below the strike price. As the option approaches its maturity, the time value declines to zero.

THE VALUE OF EXCHANGE RATE VOLATILITY Volatility of the underlying spot rate is one of the most important factors that influences the value of the option premium. Volatility measures the fluctuation in price over a given period of time. The greater the variability of the currency, the higher is the probability that the spot rate will be below or above the strike price. Thus, more volatile currencies tend to have higher option premiums.

SUMMARY Typically, options have positive values even if they are out of the money (i.e., have zero intrinsic value). Investors will usually pay something today for out of the money options on the chance of profit before maturity. They are also likely to pay some additional premium today for in the money options on the chance of an increase in intrinsic value before maturity. Thus, the price of an option is always somewhat greater than its intrinsic value.

6.2.4 *Currency call options*

A currency call option is a contract that gives the buyer the right to buy a foreign currency at a specified price during the prescribed period. People buy currency call options because they anticipate that the spot rate of the underlying currency will appreciate. Currency option trading can take place for hedging or speculation.

HEDGING IN THE CALL OPTIONS MARKET MNCs with open positions in foreign currencies can utilize currency call options. Suppose that an American firm orders industrial equipment from a German company, and its payment is to be made in euros upon delivery. A euro call option locks in the rate at which the US company can purchase euros for dollars. Such an exchange between these two currencies at the specified strike price can take place before the settlement date. Thus, the call option specifies the maximum price that the US company must pay to obtain euros. If the spot rate falls below the strike price by the delivery date, the American firm can buy euros at the prevailing spot rate to pay for its equipment and can simply let its call option expire.

Example 6.4

Let's see how call options may be used to cover possible exchange losses on import orders denominated in foreign currencies. Assume that on February 1 an American firm has purchased a mainframe computer from a Swiss firm for SFr625,000; its payment must be made in Swiss francs on June 1. Let us further assume that the premium for a franc call option with a strike price of $0.5000 and a June expiration date is 0.03 cents per franc. Because there are 62,500 units per franc option, the US firm will need 10 call options to buy SFr625,000. The current spot rate for francs is $0.4900; the US company's bank believes that the spot rate by June 1 will rise to $0.6000.

There are two alternatives available to the US company: do not hedge, or hedge in the options market. If the US company does not want to cover its open position, it would wait for 4 months, buy francs at the prevailing exchange rate in the spot market, and use these francs to pay for its imports. If the bank's forecast is accurate, the US company will spend $375,000 to purchase SFr625,000 at the spot rate of $0.6000.

The price of 10 franc call options is $187.50 (0.03 cents $\times$ 10 options $\times$ 62,500 units per contract). If the US company decides to hedge its position in the options market, on June 1 it would exercise its right to buy SFr625,000 for $312,500 ($0.500 $\times$ SFr625,000). Consequently, the US firm would spend a total of $312,687.50 ($187.50 + $312,500) to purchase SFr625,000. By doing so, the American firm would avoid the risk of a $62,312.50 loss ($375,000 – $312,687.50). Still, if the future spot rate for francs remains below the strike price of $0.5000, the US company can let its options expire and buy Swiss francs at the prevailing spot rate when it must pay for its imports. Here, the US firm would lose its option premium of $187.50.

SPECULATING IN THE CALL OPTIONS MARKET Individuals may speculate with currency call options based on their expectations of exchange rate fluctuations for a particular currency. The purpose of speculation in the call options market is to make a profit from exchange rate movements by deliberately taking an uncovered position. If a speculator expects that the future spot rate of a currency will increase, he makes the following transactions: The speculator will (1) buy call options of the currency, (2) wait for a few months until the spot rate of the currency appreciates highly enough, (3) exercise his option by buying the currency at the strike price, and (4) then sell the currency at the prevailing spot rate. When a speculator buys and then exercises a call option, his profit (loss) is determined as follows:

$$\text{profit (loss)} = \text{spot rate} - (\text{strike price} + \text{premium}) \tag{6.2}$$

Example 6.5

Suppose that the call premium per British pound on February 1 is 1.10 cents, the expiration date is June, and the strike price is $1.60. Richard Smith anticipates that the spot rate of the pound will increase to $1.70 by May 1. If Mr Smith's expectation proves correct, what would be his dollar profit from speculating one pound call option (31,250 units per contract) in the call options market?

Richard Smith could make a profit of $2,781.25 by making the following trades:

1	Buy call options on February 1	–$0.0110 per pound
2	Exercise the option on May 1	–$1.6000 per pound
3	Sell the pound on May 1	+$1.7000 per pound
4	Net profit as of May 1	+$0.0890 per pound
5	Net profit per contract: £31,250 × $0.0890 = $2,781.25	

Richard's profit of $0.0890 per pound can also be obtained by equation 6.2:

$$\text{profit} = \$1.700 - (\$1.6000 + \$0.0110) = \$0.0890$$

Richard Smith does not need to exercise his call options in order to make a profit. Currency call option premiums rise and fall as the exchange rates of their underlying currency rise and fall. If call options become profitable, their premiums will rise. They can be sold, on an exchange, just like any foreign currency itself. So a call option holder such as Mr Smith can save the expense and bother of taking possession of the currency and selling it.

Global Finance in Action 6.2

Options on Economic Data

On October 1, 2002, Goldman Sachs and Deutsche Bank began auctioning options on economic news releases. The first auction was for options on the September US nonfarm payrolls report, released on October 4, while later contracts would include US retail sales, gross domestic product, measures of consumer confidence, inflation, and German data.

The seller of the option is obligated to pay the buyer if the option ends up in the money – having a positive payout. For regulatory reasons, and to reduce the risk that options sellers might default on their obligations to the buyers, only institutional investors and hedge funds may participate in the auctions, and Goldman Sachs and/or Deutsche Bank will be the official counterparties to the buyers.

What economic good do these options on economic statistics provide? They permit companies and individuals to hedge risk, to reduce the danger that bad (or good) economic statistics will reduce their profit/wealth. For example, a construction firm might buy a put option on housing starts to hedge its risk against a slowdown in the industry. If announced housing starts are less than the strike price of the firm's put option, the firm will receive a payment that will make up for the reduced revenue that accompanies fewer housing starts. Similarly, a cruise line might hedge itself against a downturn in travel by using options on consumer confidence.

These options not only allow firms and individuals to share the risk of uncertain economic outcomes, but they also provide publicly available information about the likelihood of these outcomes. In other words, the options prices could help to forecast the distribution of the economic statistics. For example, the difference between the price of call options on September payroll growth with strike prices of 100 and 120 might be used to predict how likely it is that employment growth will be between 100,000 and 120,000. Because such forecasts are generated by firms "putting their money where their mouth is," they might be more accurate than free forecasts. If this market succeeds, such implied forecasts might help both private decision-makers and policy-makers. A Goldman Sachs press release reported that the October 1 auction implicitly predicted a drop of 38,000 in the September nonfarm payrolls. The October 3 auction predicted a drop of 18,000 jobs. In fact, the actual decline was 43,000. Thus, both predictions from the option market bested the consensus forecast of +20,000 published on September 30 in *The Wall Street Journal*. Only time will tell if such good predictions from the economic derivatives market are the exception or the rule.

Source: C. J. Neely, "Options on Economic Data," *International Economic Trends*, Federal Reserve Bank of St. Louis, Nov. 2002.

GRAPHIC ANALYSIS OF A CALL OPTION PRICE Figure 6.3 shows the typical relationship between the market value of a call option and its intrinsic value. Up to the point at which the strike price equals the spot rate, the time value increases as the spot rate increases, but the market value exceeds the intrinsic value for all spot rates. Call options have positive values even if they are out of the money, because they have time value. It is also important to note that the intrinsic value of a call option becomes zero whenever the strike price exceeds the spot rate. In other words, the intrinsic value is zero until the spot rate reaches the strike price, and then rises linearly (one cent for a one-cent increase in the spot rate).

6.2.5 *Currency put options*

A currency put option is simply a contract that gives the holder the right to sell a foreign currency at a specified price during a prescribed period. People buy currency put options because they anticipate that the spot rate of the underlying currency will depreciate.

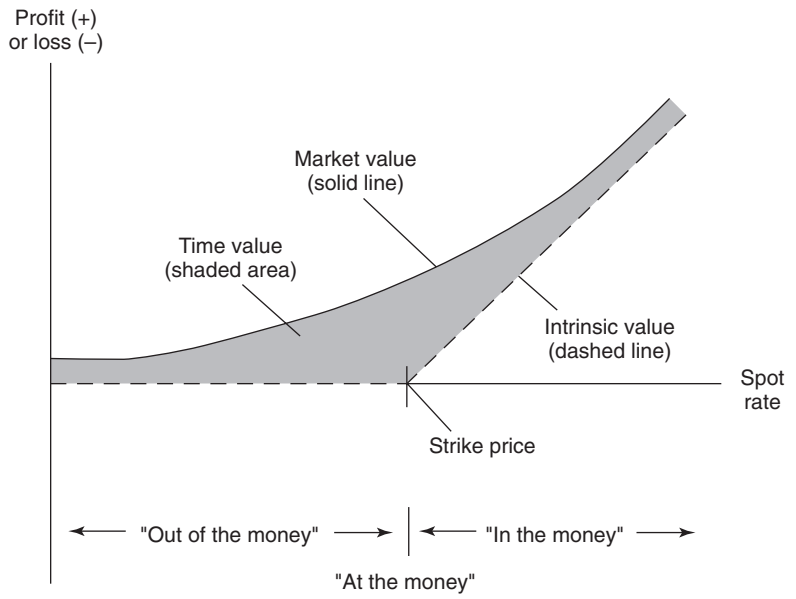

Figure 6.3 The market value of a call option

MNCs with open positions in foreign currencies can employ currency put options to cover such positions. Consider an American company that has sold an airplane to a Japanese firm and has agreed to receive its payment in Japanese yen. The exporter may be concerned about the possibility that the yen will depreciate by the time it is scheduled to receive its payment from the importer. To protect itself against such a yen depreciation, the exporter could buy yen put options, which would enable it to sell yen at the specified strike price. In fact, the exporter would lock in the minimum exchange rate at which it could sell Japanese yen in exchange for US dollars over a specified period of time. On the other hand, if the yen appreciates over this time period, the exporter could let the put options expire and sell the yen at the prevailing spot rate.

Individuals may speculate with currency put options based on their expectations of exchange rate fluctuations for a particular currency. For example, if speculators believe that the Swiss franc will depreciate in the future, they can buy franc put options, which will entitle them to sell francs at the specified strike price. If the franc's spot rate depreciates as expected, they can buy francs at the spot rate and exercise their put options by selling these francs at the strike price. If a speculator buys and then exercises a put option, his profit (loss) is determined as follows:

$$\text{profit (loss)} = \text{strike price} - (\text{spot rate} + \text{premium}) \tag{6.3}$$

For example, the profit for the holder of a put option with a strike price of \$0.585/SFr, a premium of \$0.005/SFr, and a spot rate of \$0.575/SFr is:

$$\text{profit} = \$0.585 - (\$0.575 + \$0.005) = \$0.005/\text{SFr}$$

Speculators do not need to exercise their put options in order to make a profit. They could also make a profit from selling put options, because put option premiums fall and rise as exchange

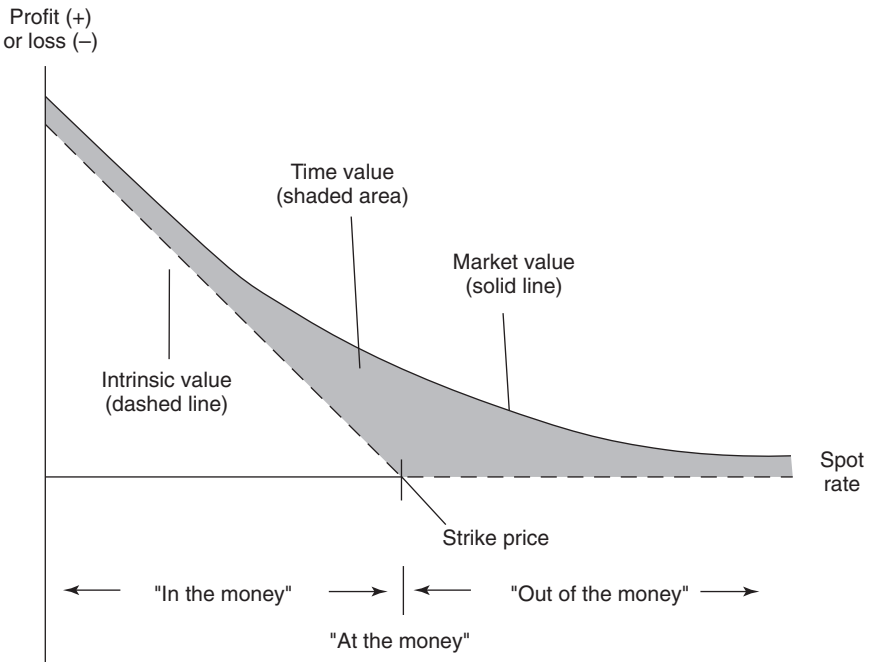

Figure 6.4 The market value of a put option

rates of the underlying currency rise and fall. The seller of put options has the obligation to purchase the specified currency at the strike price from the owner who exercises the put option. If speculators anticipate that the currency will appreciate, they might sell their put options. But if the currency indeed appreciates over the entire period, the put options will not be exercised. On the other hand, if speculators expect that the currency will depreciate, they will keep their put options. Then they will sell their put options when the put option premiums go up.

GRAPHIC ANALYSIS OF A PUT OPTION PRICE Figure 6.4 shows the typical relationship between the market value of a put option and its intrinsic value. Up to the point at which the strike price equals the spot rate, the time value declines as the spot rate increases, but the market value exceeds the intrinsic value for all spot rates. Put options have positive values even if they are out of the money, because they have time value. It is also important to note that the intrinsic value of a put option becomes zero whenever the spot rate exceeds the strike price.

6.2.6 *Profit–loss profiles of options*

Figure 6.5 presents "profit–loss profiles" that trace the relationship between the exchange rate at expiration of the contract and the net gain (loss) to the trader.

Assume that the call premium per British pound is $0.04, the strike price is $1.50, and the contract matures in 2 months. The vertical axes of figures 6.5(a) and 6.5(b) measure profit or loss for the call option trader at different spot rates (horizontal axes) for the pound at the time of maturity. For the buyer of a call option on the pound, the loss is limited to the price origi-

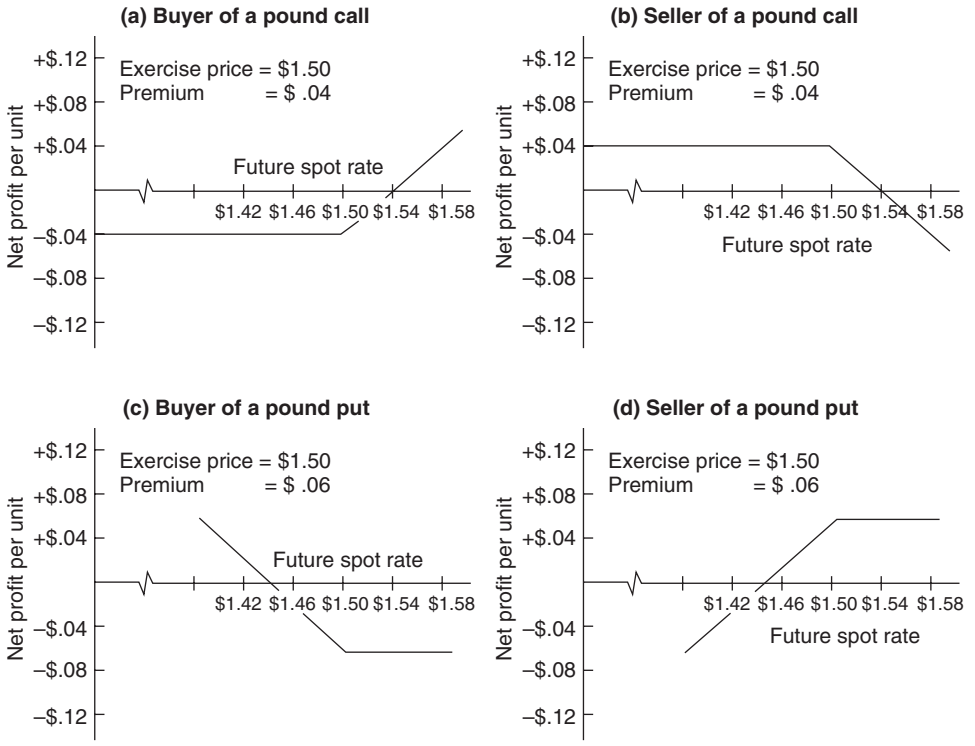

Figure 6.5 Profit–loss profiles for an option holder

nally paid for the option. The entire price ($0.04) would be lost if the spot rate was $1.50 or less. The call option holder would earn $0.04 at $1.54, but this gain would be offset by the $0.04 premium. Thus, this point ($1.54) is called the break-even point. The call option holder would realize a one-to-one gain (unlimited profit) at any spot rate above $1.54.

For the seller of a call option, the gain is limited to the premium originally charged for the option. The entire premium ($0.04) would be earned if the spot rate was $1.50 or less. The call option seller would suffer a one-to-one loss at any spot rate above $1.54.

Assume that the put premium per British pound is $0.06, the strike price is $1.50, and the contract matures in 2 months. Figures 6.5(c) and 6.5(d) show the profit–loss profiles of a put option trader. The buyer of a put option would obtain a one-to-one gain at any rate below $1.44, but only up to the point at which the profit–loss profile of the put option holder intercepts the vertical axis. The break-even spot rate of $1.44 is the price at which the holder neither gains nor loses on exercise of the option: this is the point at which the gain of $0.06 is offset by the premium of $0.06. The holder would lose money at spot rates above $1.44, but the loss would be limited to the premium originally paid for the option.

The seller of a put option would suffer a one-to-one loss at any spot rate below $1.44, but only up to the point at which the profit–loss profile intercepts the vertical axis. For the seller of a put option, the gain is limited to the premium originally charged for the option. The entire premium ($0.06) would be earned if the spot rate was $1.50 or higher.

Table 6.8 Futures positions after an option exercise

	Call option	*Put option*
Buyer assumes:	Long futures position	Short futures position
Seller assumes:	Short futures position	Long futures position

6.3 Futures Options

The Chicago Mercantile Exchange introduced currency futures options, or currency options on futures, in January 1984. Currency futures options do not reflect the options on the underlying currency itself, but they reflect the options on futures contracts of that currency. They were originally established for the German mark, but they are now available for the British pound, the Canadian dollar, the Japanese yen, the Mexican peso, and the Swiss franc. Futures options trade in an expiration cycle of March, June, September, and December, just like their underlying futures contracts.

Currency futures options give the holder the right to buy or sell a foreign currency at a designated price in the future. There are two types of currency futures options: currency futures calls and currency futures puts. A currency futures call option gives the buyer the right, but not the obligation, to buy a particular currency futures contract at a specified price at any time during the life of the option. A currency futures put option gives the buyer the right, but not the obligation, to sell a particular currency futures contract at a specified price at any time during the life of the option. Table 6.8 shows futures positions after options have been exercised.

MNCs with open positions in foreign currencies can use currency futures options to cover such positions. Individuals may speculate with currency futures options based on their expectation of exchange rate movements for a particular currency. Those who believe that the futures prices are too low could buy call options on futures. Those who believe that the futures prices are too high could buy put options on futures.

If a call futures option is exercised, the holder gets a long position in the underlying futures contract plus a cash amount equal to the current futures price minus the exercise price. If a put futures option is exercised, the holder gets a short position in the underlying futures contract plus a cash amount equal to the exercise price minus the current futures price.

Example 6.6

Consider an investor who has a June futures call option on one contract of the British pound (62,500) with a strike price of $1.580. The current futures price of the pound for delivery in June is $1.630. If the investor exercises her option, she would receive $3,125 (62,500 × 0.05) plus a long position in a futures contract to buy £62,500 in June. If desired, she can immediately close out her long position at no cost; this would leave the investor with the $3,125 cash payoff.

Example 6.7

Consider an investor who has a June futures put option on one contract of the Swiss franc (125,000) with a strike price of $0.65. The current futures price of the franc for delivery in June is $0.55. If the investor exercises her option, she receives $12,500 (125,000 × 0.10) plus a short position in a futures contract to sell SFr125,000. If desired, she can immediately close out her short position at no cost; this would leave the investor with the $12,500 cash payoff.

SUMMARY

Three major instruments of the foreign-exchange market are currency futures, currency options, and currency futures options. The three types of contracts are similar because they are all used by those who have specific expectations about future exchange rate movements. Yet they differ because: (1) holders of currency futures must buy or sell the currency on the settlement date; (2) owners of currency options have the right to buy or sell the currency at a specified price; and (3) holders of currency futures options have the right to buy or sell the futures on the currency.

These three types of currency contract are acquired for hedging, speculation, or arbitrage. They appeal to individuals and small companies because they offer standard contracts in predetermined amounts and their purchase prices are small. MNCs with open positions in foreign currencies can use these three markets to cover such positions as an alternative to the forward market offered by commercial banks.

The trading of futures and options involves six major classes of risk: credit, market, liquidity, legal, settlement, and operations. Credit risk derives from the extension of credit to counterparties that may be unwilling or unable to fulfill their contractual obligations. Market risk refers to the effect of changes in the price of the underlying instrument on the value of an open derivative position. Liquidity risk is the risk that a securities firm or bank is unable to liquidate or offset a position because of a lack of counterparties in the market. Legal risk arises when contracts are unenforceable or inadequately documented. Settlement risk happens when a counterparty fails to provide funds or instruments at the agreed time. Operations risk is a loss that results from human error or deficiencies in systems or controls.

Questions

1 What are the major differences between forward and futures contracts?
2 What is the most important difference between futures and options contracts?
3 What are the major types of margin with respect to a futures contract? What is the role of a margin requirement?
4 How can speculators use currency futures?
5 How can US companies use currency futures?
6 What are the components of an option premium?
7 Why is the price of an option always greater than its intrinsic value?
8 Why can't the intrinsic value of an option be less than zero?
9 Assume that a company wants to use either a currency option or a forward contract to hedge against exchange rate fluctuations. What are the advantages and disadvantages of currency options in this case?
10 When should a company buy a call option for hedging? When should a company buy a put option?
11 When should speculators buy a call option? When should speculators buy a put option?
12 What are currency futures options?
13 Why has the number of currency futures contracts tended downward in recent years?

Problems

1 An American company sells yen futures contracts to cover possible exchange losses on its export orders denominated in Japanese yen. The amount of the initial margin is $20,000, and the maintenance margin is 75 percent of the initial margin. The value of the company's position declines by $6,000 because the spot rate for yen has increased.
   (a) What is the dollar amount of the maintenance margin?
   (b) Should the broker issue margin calls to the company?
   (c) What is the amount of additional deposit needed to restore the account to the initial margin level?
2 A speculator enters a futures contract for September delivery (September 19) of £62,500 on February 2. The futures exchange rate is $1.650 per pound. He believes that the spot rate for pounds on September 19 will be $1.700 per pound. The margin requirement is 2 percent.
   (a) If his expectations are correct, what would be his rate of return on the investment?
   (b) If the spot rate for pounds on September 19 is 5 percent lower than the futures exchange rate, how much would he lose on the futures speculation?

(c) If there is a 65 percent chance that the spot rate for pounds will increase to $1.700 by September 19, would you speculate in the futures market?

3 On March 20, a Detroit investor decides to invest $1 million in a British 3-month certificate of deposit (CD) with an annual yield of 20 percent. He expects that this 20 percent rate of return on the British CD will be more than he could have realized by investing in the domestic market. The investor buys British pounds in the spot market and purchases the CD from a British bank. The exchange rates are $2.0000 per pound in the spot market and $2.0050 per pound in the futures market for June delivery (June 20).
   (a) The investor buys enough British pounds in the futures market to cover the principal and accrued interest at the time of maturity. Summarize the transaction.
   (b) By June 20, the British pound has depreciated to $1.8500 per pound. Remember that the spot rate and the futures rate become the same by the delivery date. On June 20, the investor decides to close the position by selling British pounds in the spot market and reversing the futures contracts. Summarize the transaction.
   (c) Compare the exchange gain (loss) from the futures transaction with the exchange loss (gain) from the spot transaction. What is the windfall profit (net exchange gain)?
   (d) If the investor had not hedged his investment, how much exchange loss would he have suffered on the transaction? Remember that the British pound has depreciated to $1.8500 on June 20.

4 The call premium per British pound on March 1 is $0.04, the expiration date is September 19, and the strike price is $1.80. A speculator believes that the spot rate for the pound will rise to $1.92 by September 19.
   (a) If the speculator's expectations are correct, what would be her dollar profit from speculating two pound call options (£62,500)?
   (b) If the spot rate were $1.76 per pound when the option expired, would the speculator exercise the options? What would be her loss from this speculation?

5 The put premium per British pound on March 1 is $0.04, the settlement date is September 19, and the strike price is $1.80. A speculator anticipates that the spot rate for the pound will fall to $1.72 by September 19. If the speculator's expectations are correct, what would be his dollar profit from speculating two put options (£62,500)?

6 A US company has bought 30 personal computers from a British company for £62,500. Its payment must be made in British pounds 90 days from now. The premium for a pound call option with a strike price of $1.60 and a 90-day expiration date is $0.04 per pound. The current spot rate for pounds is $1.58; the US company expects that the spot rate in 90 days will rise to $1.66. The US company has two alternatives: do not hedge and hedge in the options market. Should the US company choose the call option hedge or the no hedge?

7 A US exporter is scheduled to receive SFr125,000 in 60 days. The premium for a franc put option with a strike price of $0.50 and a 90-day settlement date is $0.03 per franc. The company anticipates that the spot rate in 90 days will be $0.46. Should the company hedge its accounts receivable in the options market? If the spot rate were $0.51 in 90 days, how would it affect the company's decision?

8 The exchange rate for Japanese yen is $0.0069 per yen, and a call option has a strike price of $0.0065. An investor has two yen call options. If the investor were to exercise

the call options, how much profit would he realize? (Hint: see table 6.5 for the size of a contract for yen call options and ignore option premiums.)

9 The exchange rate for Japanese yen is $0.0069 per yen, and a put option has a strike price of $0.0070. An investor has two yen put options. If the holder were to exercise the put option, how much profit would he realize? (Hint: see table 6.5 for the size of a contract for yen put options and ignore option premium.)

10 On October 23, the closing exchange rate of British pounds was $1.70. Calls that would mature the following January with a strike price of $1.75 were traded at $0.10.
   (a) Were the call options in the money, at the money, or out of the money?
   (b) Compute the intrinsic value of the call.
   (c) If the exchange rate of British pounds rises to $1.90 prior to the January option expiration date, what is the percentage return on investment for an investor who purchased a call on October 23?

11 With reference to problem 10, put options with the same strike price and a January maturity for British pounds were traded at $0.05 on October 23.
   (a) Were the put options in the money, at the money, or out of the money?
   (b) Compute the intrinsic value of the put.
   (c) If the exchange rate of British pounds falls to $1.65 just prior to expiration, what is the percentage return on investment for an investor who purchased a put on October 23?

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Case Problem 6: Merck's Use of Currency Options

The effect of foreign-currency fluctuations on a company depends on a company's business structure, its industry profile, and its competitive environment. This case recounts how Merck assessed its foreign-exchange exposure and decided to hedge those exposures.

The Company

In 2001, Merck celebrated its 110th anniversary in discovering, developing, producing, and distributing human and animal health pharmaceutical products. Today, the company does business in more than 100 countries around the world. Thus, it is part of an industry that makes its products available for the prevention, relief, and cure of disease throughout the world.

Approximately 50 percent of worldwide sales for Merck come from foreign operations. International earnings assets for the company account for 40 percent of its total earnings assets. The pharmaceutical industry is highly competitive, with no company holding more than 5 percent of the worldwide market. Merck ranks first in pharmaceutical sales in the world, but has slightly less than 5 percent market share worldwide.

As Merck became increasingly global, it continued to establish and enhance strategic alliances here in the USA and abroad, in order to discover, develop, and market innovative products. Moreover, Merck understands that future competition will be more global in nature. To prepare its managers for this broader challenge, Merck continues to expand the international nature of its management training. Programs focus increasingly on international issues such as foreign-exchange risk management, and training program participants reflect the worldwide nature of the company's businesses. For example, the senior-level managers who attended its Executive Development Programs in recent years came from 30 countries.

US pharmaceutical companies have expanded into foreign markets significantly more than have their counterparts in other industries, because they have to fund high risk and growing research expenditures. These companies also differ in their method of doing business overseas. Although many US exporters bill their customers in US dollars, most pharmaceutical companies bill their customers in local currencies. Consequently, the impact of exchange rate volatility tends to be more immediate and direct.

Foreign subsidiaries of pharmaceutical companies are typically importers of product at some stage of production. And these subsidiaries are responsible for completing, marketing, and distributing the product within the country of incorporation. Sales are denominated in local currency, but costs are denominated in a combination of local currency and the parent-country currency.

The Identification and Measurement of Exchange Exposure

Every company faces exposure to foreign-exchange risk as soon as it chooses to maintain a physical presence in a foreign country. Foreign-exchange fluctuations can affect a US

multinational company in three ways. First, the dollar value of net assets held in foreign currencies may be changed. This type of exposure is called translation or accounting exposure; it measures the effect of an exchange rate change on published financial statements of a firm. Second, the expected results of outstanding transactions, such as accounts receivable and/or accounts payable, may be changed. This sort of exposure is known as transaction exposure; it measures the effect of an exchange rate change on outstanding obligations that existed before exchange rates changed but were settled after the exchange rate change. The third type of exposure is referred to as economic exposure; it involves the potential effects of exchange rate changes on all facets of a firm's operations: product market, factor market, and capital market. Economic exposure consists of future revenue exposure and competitive exposure. Future revenue exposure is the possibility that the dollar value of future revenues expected to be earned overseas in foreign currencies may be changed. Competitive exposure is the possibility that a company's competitive position may be changed – for example, a competitor whose costs are denominated in a weak currency will have greater pricing flexibility and thus a potential competitive advantage.

Competitive exposure has been the subject of recent academic study on exchange risk management. Such exposures are best exemplified by the adverse effect of the strong dollar on the competitive position of US industry in the early 1980s. This was true not only in export markets but also in the US domestic market, where the strengthening US dollar gave Japanese and European-based manufacturers a large competitive advantage in dollar terms over domestic US producers.

With its significant presence worldwide, Merck has exposures in approximately 40 currencies. As a first step in assessing the effect of exchange rate movements on revenues and net income, Merck constructed a sales index that measures the relative strength of the dollar against a basket of currencies, weighted by the size of sales in those countries. The company used 1978 as the base year of its sales index. When the index is above 100 percent, foreign currencies have strengthened against the dollar, thereby indicating a positive exchange effect on dollar revenues (exchange gains). When the index is below 100 percent, the dollar has strengthened against the foreign currencies, thereby resulting in a negative exchange impact on dollar revenues (exchange losses). Merck evaluated its sales index from 1972 to 1988 and found that it had significant exchange exposure of its net overseas revenues.

Given the significant exchange exposure of its overseas revenues, Merck then decided to review its global allocation of resources across currencies; the main purpose of this review was to determine the extent to which revenues and costs were matched in individual currencies. The review revealed that the distribution of the company's assets differs somewhat from the sales mix, primarily because of the concentration of research, manufacturing, and headquarters operations in the USA.

Hedging Exposures with Financial Instruments

Having concluded that a diversified strategy (resource deployment) was not an appropriate way for Merck to address exchange risk, it considered the alternative of financial hedging. Thinking through this alternative involved the following five steps: (1) projecting exchange rate volatility; (2) assessing the impact of the 5-year strategic plan; (3) deciding on hedging the

exposure; (4) selecting the appropriate financial instruments; and (5) constructing a hedging program. Based on this five-step process, Merck decided to choose currency options as its risk management tool.

Identifying a company's exchange risk and deciding what action should be taken require extensive analysis. Merck management felt that, as a result of this analysis of its currency exposures, it had developed an appropriate financial hedging plan – one that insures against potentially damaging effects of currency volatility on the company's strategic plan.

Apparently, this hedging strategy has worked well for Merck since 1989 (Schlesinger 2000). Because Merck does about half its business overseas, the dollar surge in the 1980s "really put a crimp in the performance of the company" as the dollar value of foreign revenue fell, recalls Chief Financial Officer Judy Lewent. In response, the company was repeatedly forced into sudden cutbacks in planned research and development spending and capital investments. Beginning in 1989, Merck started hedging against foreign-exchange movements, a practice honed throughout the decade. Thus, even as the dollar surged against the euro last year, Ms Lewent says, "we were able to go through the year and continue our budget commitments to our operating people."

Case Questions

1 Why do you think Merck did not neutralize the impact of unexpected exchange rate changes on its future revenues through a diversification strategy?
2 Describe each of the five steps in Merck's foreign-exchange risk management process: the exchange forecasts, the impact of the strategic plan, the hedging rationale, the financial instruments, and the hedging program.
3 Why did Merck select "options" as its major hedging instrument?
4 The website of the Chicago Mercantile Exchange, www.cme.com, and the website of the Philadelphia Stock Exchange, www.phlx.com/, show a variety of information about currency futures and options. Use these websites to depict the prices of British pound futures and options.

Sources: J. C. Lewent and A. John Kearney, "Identifying, Measuring, and Hedging Currency Risk at Merck," *Journal of Applied Corporate Finance*, Winter 1990, pp. 19–28; and J. M. Schlesinger, "Why the Long Boom? It Owes a Big Debt to the Capital Markets," *The Wall Street Journal*, Feb. 1, 2000, pp. A1, A6.