5: Currency Derivatives

Given the potential shifts in the supply of or demand for currency (as explained in the previous chapter), firms and individuals who have assets denominated in foreign currencies can be affected favorably or unfavorably. They may want to alter their currency exposure in order to benefit from the expected movements. In addition, some MNCs that expect to be adversely affected by the expected movements in exchange rates may wish to hedge their exposure. This chapter provides a background on currency derivatives, which are commonly traded to capitalize on or hedge against expected exchange rate movements.

A currency derivative is a contract whose price is partially derived from the value of the underlying currency that it represents. Some individuals and financial firms take positions in currency derivatives to speculate on future exchange rate movements. MNCs commonly take positions in currency derivatives to hedge their exposure to exchange rate risk. Their managers must understand how these derivatives can be used to achieve corporate goals.

The specific objectives of this chapter are to:

- explain how forward contracts are used to hedge based on anticipated exchange rate movements,
- describe how currency futures contracts are used to speculate or hedge based on anticipated exchange rate movements, and
- explain how currency options contracts are used to speculate or hedge based on anticipated exchange rate movements.

Forward Market

The forward market facilitates the trading of forward contracts on currencies. A **forward contract** is an agreement between a corporation and a commercial bank to exchange a specified amount of a currency at a specified exchange rate (called the **forward rate**) on a specified date in the future. When multinational corporations (MNCs) anticipate a future need for or future receipt of a foreign currency, they can set up forward contracts to lock in the rate at which they can purchase or sell a particular foreign currency. Virtually all large MNCs use forward contracts. Some MNCs have forward contracts outstanding worth more than $100 million to hedge various positions.

Because forward contracts accommodate large corporations, the forward transaction will often be valued at $1 million or more. Forward contracts normally are not used by consumers or small firms. In cases when a bank does not know a corporation well or fully trust it, the bank may request that the corporation make an initial deposit to assure that it will fulfill its obligation. Such a deposit is called a compensating balance and typically does not pay interest.

The most common forward contracts are for 30, 60, 90, 180, and 360 days, although other periods (including longer periods) are available. The forward rate of a given currency will typically vary with the length (number of days) of the forward period.

How MNCs Use Forward Contracts

MNCs use forward contracts to hedge their imports. They can lock in the rate at which they obtain a currency needed to purchase imports.

EXAMPLE Turz, Inc., is an MNC based in Chicago that will need 1,000,000 Singapore dollars in 90 days to purchase Singapore imports. It can buy Singapore dollars for immediate delivery at the spot rate of $.50 per Singapore dollar (S$). At this spot rate, the firm would need $500,000 (computed as S$1,000,000 × $.50 per Singapore dollar). However, it does not have the funds right now to exchange for Singapore dollars. It could wait 90 days and then exchange U.S. dollars for Singapore dollars at the spot rate existing at that time. But Turz does not know what the spot rate will be at that time. If the rate rises to $.60 by then, Turz will need $600,000 (computed as S$1,000,000 × $.60 per Singapore dollar), an additional outlay of $100,000 due to the appreciation of the Singapore dollar.

To avoid exposure to exchange rate risk, Turz can lock in the rate it will pay for Singapore dollars 90 days from now without having to exchange U.S. dollars for Singapore dollars immediately. Specifically, Turz can negotiate a forward contract with a bank to purchase S$1,000,000 90 days forward. ■

The ability of a forward contract to lock in an exchange rate can create an opportunity cost in some cases.

EXAMPLE Assume that in the previous example, Turz negotiated a 90-day forward rate of $.50 to purchase S$1,000,000. If the spot rate in 90 days is $.47, Turz will have paid $.03 per unit or $30,000 (1,000,000 units × $.03) more for the Singapore dollars than if it did not have a forward contract. ■

Corporations also use the forward market to lock in the rate at which they can sell foreign currencies. This strategy is used to hedge against the possibility of those currencies depreciating over time.

EXAMPLE Scanlon, Inc., based in Virginia, exports products to a French firm and will receive payment of €400,000 in 4 months. It can lock in the amount of dollars to be received from this transaction by selling euros forward. That is, Scanlon can negotiate a forward contract with a bank to sell the €400,000 for U.S. dollars at a specified forward rate today. Assume the prevailing 4-month forward rate on euros is $1.10. In 4 months, Scanlon will exchange its €400,000 for $440,000 (computed as €400,000 × $1.10 = $440,000). ■

Bid/Ask Spread. Like spot rates, forward rates have a bid/ask spread. For example, a bank may set up a contract with one firm agreeing to sell the firm Singapore dollars 90 days from now at $.510 per Singapore dollar. This represents the ask rate. At the same time, the firm may agree to purchase (bid) Singapore dollars 90 days from now from some other firm at $.505 per Singapore dollar.

The spread between the bid and ask prices is wider for forward rates of currencies of developing countries, such as Chile, Mexico, South Korea, Taiwan, and Thailand. Because these markets have relatively few orders for forward contracts, banks are less able to match up willing buyers and sellers. This lack of liquidity causes banks to widen the bid/ask spread when quoting forward contracts. The contracts in these countries are generally available only for short-term horizons.

Premium or Discount on the Forward Rate. The difference between the forward rate (F) and the spot rate (S) at a given point in time is measured by the premium:

$$F = S(1 + p)$$

where p represents the forward premium, or the percentage by which the forward rate exceeds the spot rate.

EXAMPLE If the euro's spot rate is $1.03, and its one-year forward rate has a forward premium of 2 percent, the one-year forward rate is:

$$\begin{aligned} F &= S(1 + p) \\ &= \$1.03(1 + .02) \\ &= \$1.0506 \end{aligned}$$ ■

Given quotations for the spot rate and the forward rate at a given point in time, the premium can be determined by rearranging the above equation:

$$\begin{aligned} F &= S(1 + p) \\ F/S &= 1 + p \\ (F/S) - 1 &= p \end{aligned}$$

EXAMPLE If the euro's one-year forward rate is quoted at $1.0506 and the euro's spot rate is quoted at $1.03, the euro's forward premium is:

$$\begin{aligned} (F/S) - 1 &= p \\ (\$1.0506/\$1.03) - 1 &= p \\ 1.02 - 1 &= .02 \text{ or } 2 \text{ percent} \end{aligned}$$ ■

When the forward rate is less than the prevailing spot rate, the forward premium is negative, and the forward rate exhibits a discount.

EXAMPLE If the euro's one-year forward rate is quoted at $1.00 and the euro's spot rate is quoted at $1.03, the euro's forward premium is:

$$\begin{aligned} (F/S) - 1 &= p \\ (\$1.00/\$1.03) - 1 &= p \\ .9709 - 1 &= -.0291 \text{ or } -2.91 \text{ percent} \end{aligned}$$

Since p is negative, the forward rate contains a discount. ■

EXAMPLE Assume the forward exchange rates of the British pound for various maturities are as shown in the second column of Exhibit 5.1. Based on each forward exchange rate, the forward discount can be computed on an annualized basis, as shown in Exhibit 5.1. ■

In some situations, a firm may prefer to assess the premium or discount on an unannualized basis. In this case, it would not include the fraction that represents the number of periods per year in the formula.

Exhibit 5.1 Computation of Forward Rate Premiums or Discounts

Type of Exchange Rate for £	Value	Maturity	Forward Rate Premium or Discount for £
Spot rate	$1.681		
30-day forward rate	$1.680	30 days	$\frac{\$1.680 - \$1.681}{\$1.681} \times \frac{360}{30} = -.71\%$
90-day forward rate	$1.677	90 days	$\frac{\$1.677 - \$1.681}{\$1.681} \times \frac{360}{90} = -.95\%$
180-day forward rate	$1.672	180 days	$\frac{\$1.672 - \$1.681}{\$1.681} \times \frac{360}{180} = -1.07\%$

Arbitrage. Forward rates typically differ from the spot rate for any given currency. If the forward rate were the same as the spot rate, and interest rates of the two countries differed, it would be possible for some investors (under certain assumptions) to use **arbitrage** to earn higher returns than would be possible domestically without incurring additional risk (as explained in Chapter 7). Consequently, the forward rate usually contains a premium (or discount) that reflects the difference between the home interest rate and the foreign interest rate.

HTTP://

http://www.bmonesbittburns.com/economic/regular/fxrates
Forward rates of the Canadian dollar, British pound, euro, and Japanese yen for various periods. The website shows the forward rate of the British pound, the euro, and the Japanese yen against the Canadian dollar and against the U.S. dollar.

Movements in the Forward Rate over Time. If the forward rate's premium remained constant, the forward rate would move in perfect tandem with the movements in the corresponding spot rate over time. For example, if the spot rate of the euro increased by 4 percent from a month ago until today, the forward rate would have to increase by 4 percent as well over the same period in order to maintain the same premium. In reality, the forward premium is influenced by the interest rate differential between the two countries (as explained in Chapter 7) and can change over time. Most of the movement in a currency's forward rate over time is due to movements in that currency's spot rate.

Offsetting a Forward Contract. In some cases, an MNC may desire to offset a forward contract that it previously created.

EXAMPLE On March 10, Green Bay, Inc., hired a Canadian construction company to expand its office and agreed to pay C$200,000 for the work on September 10. It negotiated a 6-month forward contract to obtain C$200,000 at $.70 per unit, which would be used to pay the Canadian firm in 6 months. On April 10, the construction company informed Green Bay that it would not be able to perform the work as promised. Therefore, Green Bay offset its existing contract by negotiating a forward contract to sell C$200,000 for the date of September 10. However, the spot rate of the Canadian dollar had decreased over the last month, and the prevailing forward contract price for September 10 is $.66. Green Bay now has a forward contract to sell C$200,000 on September 10, which offsets the other contract it has to buy C$200,000 on September 10. The forward rate was $.04 per unit less on its forward sale than on its forward purchase, resulting in a cost of $8,000 (C$200,000 × $.04). ■

If Green Bay in the preceding example negotiates the forward sale with the same bank where it negotiated the forward purchase, it may simply be able to request that its initial forward contract be offset. The bank will charge a fee for this service, which will reflect the difference between the forward rate at the time of the forward purchase and the forward rate at the time of the offset. Thus, the MNC cannot just ignore its obligation, but must pay a fee to offset its original obligation.

Using Forward Contracts for Swap Transactions. A swap transaction involves a spot transaction along with a corresponding forward contract that will ultimately reverse the spot transaction. Many forward contracts are negotiated for this purpose.

EXAMPLE Soho, Inc., needs to invest 1 million Chilean pesos in its Chilean subsidiary for the production of additional products. It wants the subsidiary to repay the pesos in one year. Soho wants to lock in the rate at which the pesos can be converted back into dollars in one year, and it uses a one-year forward contract for this purpose. Soho contacts its bank and requests the following swap transaction:

1. *Today:* The bank should withdraw dollars from Soho's U.S. account, convert the dollars to pesos in the spot market, and transmit the pesos to the subsidiary's account.
2. *In one year:* The bank should withdraw 1 million pesos from the subsidiary's account, convert them to dollars at today's forward rate, and transmit them to Soho's U.S. account.

Soho, Inc., is not exposed to exchange rate movements due to the transaction because it has locked in the rate at which the pesos will be converted back to dollars. If the one-year forward rate exhibits a discount, however, Soho will receive fewer dollars in one year than it invested in the subsidiary today. It may still be willing to engage in the swap transaction under these circumstances in order to remove uncertainty about the dollars it will receive in one year. ■

Non-Deliverable Forward Contracts

A new type of forward contract called a **non-deliverable forward contract (NDF)** is frequently used for currencies in emerging markets. Like a regular forward contract, an NDF represents an agreement regarding a position in a specified amount of a specified currency, a specified exchange rate, and a specified future settlement date. However, an NDF does not result in an actual exchange of the currencies at the future date. That is, there is no delivery. Instead, one party to the agreement makes a payment to the other party based on the exchange rate at the future date.

EXAMPLE Jackson, Inc., an MNC based in Wyoming, determines as of April 1 that it will need 100 million Chilean pesos to purchase supplies on July 1. It can negotiate an NDF with a local bank as follows. The NDF will specify the currency (Chilean peso), the settlement date (90 days from now), and a so-called reference rate, which identifies the type of exchange rate that will be marked to market at the settlement. Specifically, the NDF will contain the following information:

- Buy 100 million Chilean pesos.
- Settlement date: July 1.
- Reference index: Chilean peso's closing exchange rate (in dollars) quoted by Chile's central bank in 90 days.

Assume that the Chilean peso (which is the reference index) is currently valued at $.0020, so the dollar amount of the position is $200,000 at the time of the agreement. At the time of the settlement date (July 1), the value of the reference index is determined, and a payment is made between the two parties to settle the NDF. For example, if the peso value increases to $.0023 by July 1, the value of the position specified in the NDF will be $230,000 ($.0023 × 100 million pesos). Since the value of Jackson's NDF position is $30,000 higher than when the agreement was created, Jackson will receive a payment of $30,000 from the bank.

Recall that Jackson needs 100 million pesos to buy imports. Since the peso's spot rate rose from April 1 to July 1, Jackson will need to pay $30,000 more for the imports than if it had paid for them on April 1. At the same time, however, Jackson will have received a payment of $30,000 due to its NDF. Thus, the NDF hedged the exchange rate risk.

If the Chilean peso had depreciated to $.0018 instead of rising, Jackson's position in its NDF would have been valued at $180,000 (100 million pesos × $.0018) at the settlement date, which is $20,000 less than the value when the agreement was created. Therefore, Jackson would have owed the bank $20,000 at that time. However, the decline in the spot rate of the peso means that Jackson would pay $20,000 less for the imports than if it had paid for them on April 1. Thus, an offsetting effect would also occur in this example. ■

As these examples show, although an NDF does not involve delivery, it can effectively hedge future foreign currency payments that are anticipated by an MNC.

Since an NDF can specify that any payments between the two parties be in dollars or some other available currency, firms can even use NDFs to hedge existing positions of foreign currencies that are not convertible. Consider an MNC that expects to receive payment in a foreign currency that cannot be converted into dollars. Though the MNC may use the currency to make purchases in the local country of concern, it still may desire to hedge against a decline in the value of the currency over the period before it receives payment. It takes a sell position in an NDF and uses the closing exchange rate of that currency as of the settlement date as the reference index. If the currency depreciates against the dollar over time, the firm will receive the difference between the dollar value of the position when the NDF contract was created and the dollar value of the position as of the settlement date. Thus, it will receive a payment in dollars from the NDF to offset any depreciation in the currency over the period of concern.

HTTP://

http://www.futuresmag.com/library/contents.html
Various aspects of derivatives trading such as new products, strategies, and market analyses.

Currency Futures Market

Currency futures contracts are contracts specifying a standard volume of a particular currency to be exchanged on a specific settlement date. Thus, currency futures contracts are similar to forward contracts in terms of their obligation, but differ from forward contracts in the way they are traded. They are commonly used by MNCs to hedge their foreign currency positions. In addition, they are traded by speculators who hope to capitalize on their expectations of exchange rate movements. A buyer of a currency futures contract locks in the exchange rate to be paid for a foreign currency at a future point in time. Alternatively, a seller of a currency futures contract locks in the exchange rate at which a foreign currency can be exchanged for the home currency. In the United States, currency futures contracts are purchased to lock in the amount of dollars needed to obtain a specified amount of a particular foreign currency; they are sold to lock in the amount of dollars to be received from selling a specified amount of a particular foreign currency.

Contract Specifications

HTTP://

http://www.cme.com
Time series on financial futures and option prices. The site also allows for the generation of historic price charts.

Currency futures contracts are available for several widely traded currencies at the Chicago Mercantile Exchange (CME); the contract for each currency specifies a standardized number of units (see Exhibit 5.2).

The typical currency futures contract is based on a currency value in terms of U.S. dollars. However, futures contracts are also available on some cross-rates, such as the exchange rate between the Australian dollar and the Canadian dollar. Thus, speculators who expect that the Australian dollar will move substantially against the Canadian dollar can take a futures position to capitalize on their expectations. In addition, Australian firms that have exposure in Canadian dollars or Canadian firms that have exposure in Australian dollars may use this type of futures contract to hedge their exposure. See **http://www.cme.com** for more information about futures on cross exchange rates.

Currency futures contracts typically specify the third Wednesday in March, June, September, or December as the settlement date. There is also an over-the-counter currency futures market, where financial intermediaries facilitate trading of currency futures contracts with specific settlement dates. Contracts have to be standardized, or floor trading would slow down considerably while brokers assessed contract specifications.

Trading Futures

Firms or individuals can execute orders for currency futures contracts by calling brokerage firms that serve as intermediaries. The order to buy or sell a currency futures

Exhibit 5.2 Currency Futures Contracts Traded on the Chicago Mercantile Exchange

Currency	Units per Contract
Australian dollar	100,000
Brazilian real	100,000
British pound	62,500
Canadian dollar	100,000
Czech koruna	4,000,000
Euro	125,000
Hungarian forint	30,000,000
Japanese yen	12,500,000
Mexican peso	500,000
New Zealand dollar	100,000
Norwegian krone	2,000,000
Polish zloty	500,000
Russian ruble	2,500,000
South African rand	500,000
Swedish krona	2,000,000
Swiss franc	125,000

contract for a specific currency and a specific settlement date is communicated to the brokerage firm, which in turn communicates the order to the CME. A floor broker at the CME who specializes in that type of currency futures contract stands at a specific spot at the trading pit where that type of contract is traded and attempts to find a counterparty to fulfill the order. For example, if an MNC wants to purchase a Mexican peso futures contract with a December settlement date, the floor broker assigned to execute this order will look for another floor broker who has an order to sell a Mexican peso futures contract with a December settlement date.

Trading on the floor (in the trading pits) of the CME takes place from 7:20 A.M. to 2:00 P.M. (Chicago time) Monday through Friday. Currency futures contracts can also be traded on the CME's automated order-entry and matching system called GLOBEX, which typically is open 23 hours per day (closed from 4 P.M. to 5 P.M.). The GLOBEX system matches buy and sell orders for each type of currency futures contract. E-mini futures for some currencies are also traded on the GLOBEX system; they specify half the number of units of the standard futures contract.

When participants in the currency futures market take a position, they need to establish an initial margin, which may represent as little as 10 percent of the contract value. The margin required is in the form of cash for small investors or Treasury securities for institutional investors. In addition to the initial margin, participants are subject to a variation margin, which is intended to accumulate a sufficient amount of funds to back the futures position. Full-service brokers typically charge a commission of about $50 for a round-trip trade in currency futures, while discount brokers charge a commission of about $20. Some Internet brokers also trade currency futures.

EXAMPLE Assume that as of February 10, a futures contract on 62,500 British pounds with a March settlement date is priced at $1.50 per pound. The buyer of this currency fu-

tures contract will receive £62,500 on the March settlement date and will pay $93,750 for the pounds (computed as £62,500 × $1.50 per pound plus a commission paid to the broker). The seller of this contract is obligated to sell £62,500 at a price of $1.50 per pound and therefore will receive $93,750 on the settlement date, minus the commission that it owes the broker. ■

Comparison of Currency Futures and Forward Contracts

Currency futures contracts are similar to forward contracts in that they allow a customer to lock in the exchange rate at which a specific currency is purchased or sold for a specific date in the future. Nevertheless, there are some differences between currency futures contracts and forward contracts, which are summarized in Exhibit 5.3. Currency futures contracts are sold on an exchange, while each forward contract is negotiated between a firm and a commercial bank over a telecommunications network. Thus, forward contracts can be tailored to the needs of the firm, while currency futures contracts are standardized.

Corporations that have established relationships with large banks tend to use forward contracts rather than futures contracts because forward contracts are tailored to the precise amount of currency to be purchased or sold in the future and the precise forward date that they prefer. Conversely, small firms and individuals who do not have established relationships with large banks or prefer to trade in smaller amounts tend to use currency futures contracts.

Pricing Currency Futures

The price of currency futures normally will be similar to the forward rate for a given currency and settlement date. This relationship is enforced by the potential arbitrage activity that would occur if there were significant discrepancies.

EXAMPLE Assume that the currency futures price on the British pound is $1.50 and that forward contracts for a similar period are available for $1.48. Firms may attempt to purchase

Exhibit 5.3 Comparison of the Forward and Futures Markets

	Forward	Futures
Size of contract	Tailored to individual needs.	Standardized.
Delivery date	Tailored to individual needs.	Standardized.
Participants	Banks, brokers, and multinational companies. Public speculation not encouraged.	Banks, brokers, and multinational companies. Qualified public speculation encouraged.
Security deposit	None as such, but compensating bank balances or lines of credit required.	Small security deposit required.
Clearing operation	Handling contingent on individual banks and brokers. No separate clearinghouse function.	Handled by exchange clearinghouse. Daily settlements to the market price.
Marketplace	Telecommunications network.	Central exchange floor with worldwide communications.
Regulation	Self-regulating.	Commodity Futures Trading Commission; National Futures Association.
Liquidation	Most settled by actual delivery. Some by offset, at a cost.	Most by offset, very few by delivery.
Transaction costs	Set by "spread" between bank's buy and sell prices.	Negotiated brokerage fees.

Source: Chicago Mercantile Exchange.

forward contracts and simultaneously sell currency futures contracts. If they can exactly match the settlement dates of the two contracts, they can generate guaranteed profits of $.02 per unit. These actions will place downward pressure on the currency futures price. The futures contract and forward contracts of a given currency and settlement date should have the same price, or else guaranteed profits are possible (assuming no transaction costs). ■

HTTP://

http://www.cme.com
Provides the open price, high and low prices for the day, closing (last) price, and trading volume.

The currency futures price differs from the spot rate for the same reasons that a forward rate differs from the spot rate. If a currency's spot and futures prices were the same and the currency's interest rate were higher than the U.S. rate, U.S. speculators could lock in a higher return than they would receive on U.S. investments. They could purchase the foreign currency at the spot rate, invest the funds at the attractive interest rate, and simultaneously sell currency futures to lock in the exchange rate at which they could reconvert the currency back to dollars. If the spot and futures rates were the same, there would be neither a gain nor a loss on the currency conversion. Thus, the higher foreign interest rate would provide a higher yield on this type of investment. The actions of investors to capitalize on this opportunity would place upward pressure on the spot rate and downward pressure on the currency futures price, causing the futures price to fall below the spot rate.

Credit Risk of Currency Futures Contracts

Each currency futures contract represents an agreement between a client and the exchange clearinghouse, even though the exchange has not taken a position. To illustrate, assume you call a broker to request the purchase of a British pound futures contract with a March settlement date. Meanwhile, another person unrelated to you calls a broker to request the sale of a similar futures contract. Neither party needs to worry about the credit risk of the counterparty. The exchange clearinghouse assures that you will receive whatever is owed to you as a result of your currency futures position.

To minimize its risk in such a guarantee, the CME imposes **margin requirements** to cover fluctuations in the value of a contract, meaning that the participants must make a deposit with their respective brokerage firms when they take a position. The initial margin requirement is typically between $1,000 and $2,000 per currency futures contract. However, if the value of the futures contract declines over time, the buyer may be asked to add to the initial margin. Margin requirements are not always required for forward contracts due to the more personal nature of the agreement; the bank knows the firm it is dealing with and may trust it to fulfill its obligation.

Speculation with Currency Futures

Currency futures contracts are sometimes purchased by speculators who are simply attempting to capitalize on their expectation of a currency's future movement.

EXAMPLE Assume that speculators expect the British pound to appreciate in the future. They can purchase a futures contract that will lock in the price at which they buy pounds at a specified settlement date. On the settlement date, they can purchase their pounds at the rate specified by the futures contract and then sell these pounds at the spot rate. If the spot rate has appreciated by this time in accordance with their expectations, they will profit from this strategy. ■

Currency futures are often sold by speculators who expect that the spot rate of a currency will be less than the rate at which they would be obligated to sell it.

EXAMPLE Assume that as of April 4, a futures contract specifying 500,000 Mexican pesos and a June settlement date is priced at $.09. On April 4, speculators who expect the peso

will decline sell futures contracts on pesos. Assume that on June 17 (the settlement date), the spot rate of the peso is $.08. The transactions are shown in Exhibit 5.4 (the margin deposited by the speculators is not considered). The gain on the futures position is $5,000, which represents the difference between the amount received ($45,000) when selling the pesos in accordance with the futures contract versus the amount paid ($40,000) for those pesos in the spot market. ■

Of course, expectations are often incorrect. It is because of different expectations that some speculators decide to purchase futures contracts while other speculators decide to sell the same contracts at a given point in time.

Currency Futures Market Efficiency. If the currency futures market is efficient, the futures price for a currency at any given point in time should reflect all available information. That is, it should represent an unbiased estimate of the respective currency's spot rate on the settlement date. Thus, the continual use of a particular strategy to take positions in currency futures contracts should not lead to abnormal profits. Some positions will likely result in gains while others will result in losses, but over time, the gains and losses should offset. Research has found that in some years, the futures price has consistently exceeded the corresponding price as of the settlement date, while in other years, the futures price has consistently been below the corresponding price as of the settlement date. This suggests that the currency futures market may be inefficient. However, the patterns are not necessarily observable until after they occur, which means that it may be difficult to consistently generate abnormal profits from speculating in currency futures.

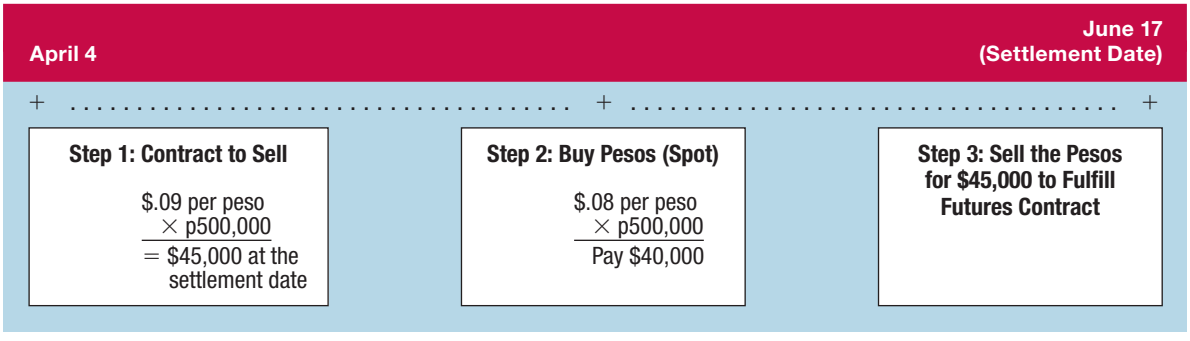
How Firms Use Currency Futures

Corporations that have open positions in foreign currencies can consider purchasing or selling futures contracts to offset their positions.

Purchasing Futures to Hedge Payables. The purchase of futures contracts locks in the price at which a firm can purchase a currency.

EXAMPLE Teton Co. orders Canadian goods and upon delivery will need to send C$500,000 to the Canadian exporter. Thus, Teton purchases Canadian dollar futures contracts today, thereby locking in the price to be paid for Canadian dollars at a future settlement date. By holding futures contracts, Teton does not have to worry about changes in the spot rate of the Canadian dollar over time. ■

Exhibit 5.4 Source of Gains from Buying Currency Futures



Selling Futures to Hedge Receivables. The sale of futures contracts locks in the price at which a firm can sell a currency.

EXAMPLE Karla Co. sells futures contracts when it plans to receive a currency from exporting that it will not need (it accepts a foreign currency when the importer prefers that type of payment). By selling a futures contract, Karla Co. locks in the price at which it will be able to sell this currency as of the settlement date. Such an action can be appropriate if Karla expects the foreign currency to depreciate against Karla's home currency. ■

The use of futures contracts to cover, or **hedge,** a firm's currency positions is described more thoroughly in Chapter 11.

Closing Out a Futures Position

If a firm that buys a currency futures contract decides before the settlement date that it no longer wants to maintain its position, it can close out the position by selling an identical futures contract. The gain or loss to the firm from its previous futures position is dependent on the price of purchasing futures versus selling futures.

The price of a futures contract changes over time in accordance with movements in the spot rate and also with changing expectations about the spot rate's value as of the settlement date.

If the spot rate of a currency increases substantially over a one-month period, the futures price will likely increase by about the same amount. In this case, the purchase and subsequent sale of a futures contract would be profitable. Conversely, a decline in the spot rate over time will correspond with a decline in the currency futures price, meaning that the purchase and subsequent sale of a futures contract would result in a loss. While the purchasers of the futures contract could decide not to close out their position under such conditions, the losses from that position could increase over time.

EXAMPLE On January 10, Tacoma Co. anticipates that it will need Australian dollars (A$) in March when it orders supplies from an Australian supplier. Consequently, Tacoma purchases a futures contract specifying A$100,000 and a March settlement date (which is March 19 for this contract). On January 10, the futures contract is priced at $.53 per A$. On February 15, Tacoma realizes that it will not need to order supplies because it has reduced its production levels. Therefore, it has no need for A$ in March. It sells a futures contract on A$ with the March settlement date to offset the contract it purchased in January. At this time, the futures contract is priced at $.50 per A$. On March 19 (the settlement date), Tacoma has offsetting positions in futures contracts. However, the price when the futures contract was purchased was higher than the price when an identical contract was sold, so Tacoma incurs a loss from its futures positions. Tacoma's transactions are summarized in Exhibit 5.5. Move from left to right along the time line to review the transactions. The example does not include margin requirements. ■

Exhibit 5.5 Closing Out a Futures Contract

January 10	February 15	March 19 (Settlement Date)
Step 1: Contract to Buy	**Step 2: Contract to Sell**	**Step 3: Settle Contracts**
$.53 per A$ × A$100,000 = $53,000 at the settlement date	$.50 per A$ × A$100,000 = $50,000 at the settlement date	− $53,000 (Contract 1) + $50,000 (Contract 2) = $3,000 loss

Sellers of futures contracts can close out their positions by purchasing currency futures contracts with similar settlement dates. Most currency futures contracts are closed out before the settlement date.

Trading Platforms for Currency Futures

There are electronic trading platforms that facilitate the trading of currency futures. These platforms serve as a broker, as they execute the trades desired. The platform typically sets quotes for currency futures based on an ask price at which one can buy a specified currency for a specified settlement date, and a bid price at which one can sell a specified currency. Users of the platforms incur a fee in the form of a difference between the bid and ask prices.

Currency Options Market

Currency options provide the right to purchase or sell currencies at specified prices. They are available for many currencies, including the Australian dollar, British pound, Brazilian real, Canadian dollar, euro, Japanese yen, Mexican peso, New Zealand dollar, Russian ruble, South African rand, and Swiss franc.

Option Exchanges

In late 1982, exchanges in Amsterdam, Montreal, and Philadelphia first allowed trading in standardized foreign currency options. Since that time, options have been offered on the Chicago Mercantile Exchange and the Chicago Board Options Exchange. Currency options are traded through the GLOBEX system at the Chicago Mercantile Exchange, even after the trading floor is closed. Thus, currency options are traded virtually around the clock.

The options exchanges in the United States are regulated by the Securities and Exchange Commission. Options can be purchased or sold through brokers for a commission. The commission per transaction is commonly $30 to $60 for a single currency option, but it can be much lower per contract when the transaction involves multiple contracts. Brokers require that a margin be maintained during the life of the contract. The margin is increased for clients whose option positions have deteriorated. This protects against possible losses if the clients do not fulfill their obligations.

Over-the-Counter Market

In addition to the exchanges where currency options are available, there is an over-the-counter market where currency options are offered by commercial banks and brokerage firms. Unlike the currency options traded on an exchange, the over-the-counter market offers currency options that are tailored to the specific needs of the firm. Since these options are not standardized, all the terms must be specified in the contracts. The number of units, desired strike price, and expiration date can be tailored to the specific needs of the client. When currency options are not standardized, there is less liquidity and a wider bid/ask spread.

The minimum size of currency options offered by financial institutions is normally about $5 million. Since these transactions are conducted with a specific financial institution rather than an exchange, there are no credit guarantees. Thus, the agreement made is only as safe as the parties involved. For this reason, financial institutions may require some collateral from individuals or firms desiring to purchase or sell currency options. Currency options are classified as either **calls** or **puts,** as discussed in the next section.

Currency Call Options

A **currency call option** grants the right to buy a specific currency at a designated price within a specific period of time. The price at which the owner is allowed to buy that currency is known as the **exercise price** or **strike price,** and there are monthly expiration dates for each option.

Call options are desirable when one wishes to lock in a maximum price to be paid for a currency in the future. If the spot rate of the currency rises above the strike price, owners of call options can "exercise" their options by purchasing the currency at the strike price, which will be cheaper than the prevailing spot rate. This strategy is somewhat similar to that used by purchasers of futures contracts, but the futures contracts require an obligation, while the currency option does not. The owner can choose to let the option expire on the expiration date without ever exercising it. Owners of expired call options will have lost the premium they initially paid, but that is the most they can lose.

Currency options quotations are summarized each day in various financial newspapers. Although currency options typically expire near the middle of the specified month, some of them expire at the end of the specific month and are designated as EOM. Some options are listed as "European Style," which means that they can be exercised only upon expiration.

A currency call option is said to be *in the money* when the present exchange rate exceeds the strike price, *at the money* when the present exchange rate equals the strike price, and *out of the money* when the present exchange rate is less than the strike price. For a given currency and expiration date, an in-the-money call option will require a higher premium than options that are at the money or out of the money.

Factors Affecting Currency Call Option Premiums

The premium on a call option represents the cost of having the right to buy the underlying currency at a specified price. For MNCs that use currency call options to hedge, the premium reflects a cost of insurance or protection to the MNCs.

The call option premium (referred to as C) is primarily influenced by three factors:

$$C = f(S - X, T, \sigma)$$
$$\quad\; + \quad + +$$

HTTP://

http://www.ino.com
The latest information and prices of options and financial futures as well as the corresponding historic price charts.

where $S - X$ represents the difference between the spot exchange rate (S) and the strike or exercise price (X), T represents the time to maturity, and σ represents the volatility of the currency, as measured by the standard deviation of the movements in the currency. The relationships between the call option premium and these factors are summarized next.

- *Level of existing spot price relative to strike price.* The higher the spot rate relative to the strike price, the higher the option price will be. This is due to the higher probability of buying the currency at a substantially lower rate than what you could sell it for. This relationship can be verified by comparing premiums of options for a specified currency and expiration date that have different strike prices.
- *Length of time before the expiration date.* It is generally expected that the spot rate has a greater chance of rising high above the strike price if it has a longer period of time to do so. A settlement date in June allows two additional months beyond April for the spot rate to move above the strike price. This explains why June option prices exceed April option prices given a specific strike price. This

relationship can be verified by comparing premiums of options for a specified currency and strike price that have different expiration dates.

- *Potential variability of currency.* The greater the variability of the currency, the higher the probability that the spot rate can rise above the strike price. Thus, less volatile currencies have lower call option prices. For example, the Canadian dollar is more stable than most other currencies. If all other factors are similar, Canadian call options should be less expensive than call options on other foreign currencies.

The potential currency variability can also vary over time for a particular currency. For example, at the beginning of the Asian crisis in 1997, the Asian countries experienced financial problems, and their currency values were subject to much more uncertainty. Consequently, the premium on over-the-counter options of Asian currencies such as the Thai baht, Indonesian rupiah, and Korean won increased. The higher premium was necessary to compensate those who were willing to sell options in these currencies, as the risk to sellers had increased because the currencies had become more volatile.

How Firms Use Currency Call Options

Corporations with open positions in foreign currencies can sometimes use currency call options to cover these positions.

Using Call Options to Hedge Payables. MNCs can purchase call options on a currency to hedge future payables.

EXAMPLE When Pike Co. of Seattle orders Australian goods, it makes a payment in Australian dollars to the Australian exporter upon delivery. An Australian dollar call option locks in a maximum rate at which Pike can exchange dollars for Australian dollars. This exchange of currencies at the specified strike price on the call option contract can be executed at any time before the expiration date. In essence, the call option contract specifies the maximum price that Pike must pay to obtain these Australian imports. If the Australian dollar's value remains below the strike price, Pike can purchase Australian dollars at the prevailing spot rate when it needs to pay for its imports and simply let its call option expire. ■

Options may be more appropriate than futures or forward contracts for some situations. Intel Corp. uses options to hedge its order backlog in semiconductors. If an order is canceled, it has the flexibility to let the option contract expire. With a forward contract, it would be obligated to fulfill its obligation even though the order was canceled.

Using Call Options to Hedge Project Bidding. U.S.-based MNCs that bid for foreign projects may purchase call options to lock in the dollar cost of the potential expenses.

EXAMPLE Kelly Co. is an MNC based in Fort Lauderdale that has bid on a project sponsored by the Canadian government. If the bid is accepted, Kelly will need approximately C$500,000 to purchase Canadian materials and services. However, Kelly will not know whether the bid is accepted until 3 months from now. In this case, it can purchase call options with a 3-month expiration date. Ten call option contracts will cover the entire amount of potential exposure. If the bid is accepted, Kelly can use the options to purchase the Canadian dollars needed. If the Canadian dollar has depreciated over time, Kelly will likely let the options expire.

Assume that the exercise price on Canadian dollars is $.70 and the call option premium is $.02 per unit. Kelly will pay $1,000 per option (since there are 50,000 units per Canadian

dollar option), or $10,000 for the 10 option contracts. With the options, the maximum amount necessary to purchase the C$500,000 is $350,000 (computed as $.70 per Canadian dollar × C$500,000). The amount of U.S. dollars needed would be less if the Canadian dollar's spot rate were below the exercise price at the time the Canadian dollars were purchased.

Even if Kelly's bid is rejected, it will exercise the currency call option if the Canadian dollar's spot rate exceeds the exercise price before the option expires and would then sell the Canadian dollars in the spot market. Any gain from exercising may partially or even fully offset the premium paid for the options. ■

This type of example is quite common. When Air Products and Chemicals was hired to perform some projects, it needed capital equipment from Germany. The purchase of equipment was contingent on whether the firm was hired for the projects. The company used options to hedge this possible future purchase.

Using Call Options to Hedge Target Bidding. Firms can also use call options to hedge a possible acquisition.

EXAMPLE Morrison Co. is attempting to acquire a French firm and has submitted its bid in euros. Morrison has purchased call options on the euro because it will need euros to purchase the French company's stock. The call options hedge the U.S. firm against the potential appreciation of the euro by the time the acquisition occurs. If the acquisition does not occur and the spot rate of the euro remains below the strike price, Morrison Co. can let the call options expire. If the acquisition does not occur and the spot rate of the euro exceeds the strike price, Morrison Co. can exercise the options and sell the euros in the spot market. Alternatively, Morrison Co. can sell the call options it is holding. Either of these actions may offset part or all of the premium paid for the options. ■

Speculating with Currency Call Options

Because this text focuses on multinational financial management, the corporate use of currency options is more important than the speculative use. The use of options for hedging is discussed in detail in Chapter 11. Speculative trading is discussed here in order to provide more of a background on the currency options market.

Individuals may speculate in the currency options market based on their expectation of the future movements in a particular currency. Speculators who expect that a foreign currency will appreciate can purchase call options on that currency. Once the spot rate of that currency appreciates, the speculators can exercise their options by purchasing that currency at the strike price and then sell the currency at the prevailing spot rate.

Just as with currency futures, for every buyer of a currency call option there must be a seller. A seller (sometimes called a **writer**) of a call option is obligated to sell a specified currency at a specified price (the strike price) up to a specified expiration date. Speculators may sometimes want to sell a currency call option on a currency that they expect will depreciate in the future. The only way a currency call option will be exercised is if the spot rate is higher than the strike price. Thus, a seller of a currency call option will receive the premium when the option is purchased and can keep the entire amount if the option is not exercised. When it appears that an option will be exercised, there will still be sellers of options. However, such options will sell for high premiums due to the high risk that the option will be exercised at some point.

The net profit to a speculator who trades call options on a currency is based on a comparison of the selling price of the currency versus the exercise price paid for the currency and the premium paid for the call option.

EXAMPLE Jim is a speculator who buys a British pound call option with a strike price of $1.40 and a December settlement date. The current spot price as of that date is about $1.39. Jim pays a premium of $.012 per unit for the call option. Assume there are no brokerage fees. Just before the expiration date, the spot rate of the British pound reaches $1.41. At this time, Jim exercises the call option and then immediately sells the pounds at the spot rate to a bank. To determine Jim's profit or loss, first compute his revenues from selling the currency. Then, subtract from this amount the purchase price of pounds when exercising the option, and also subtract the purchase price of the option. The computations follow. Assume one option contract specifies 31,250 units.

	Per Unit	Per Contract
Selling price of £	$1.41	$44,063 ($1.41 × 31,250 units)
− Purchase price of £	−1.40	−43,750 ($1.40 × 31,250 units)
− Premium paid for option	−.012	−375 ($.012 × 31,250 units)
= Net profit	−$.002	−$62 (−$.002 × 31,250 units)

Assume that Linda was the seller of the call option purchased by Jim. Also assume that Linda would purchase British pounds only if and when the option was exercised, at which time she must provide the pounds at the exercise price of $1.40. Using the information in this example, Linda's net profit from selling the call option is derived here:

	Per Unit	Per Contract
Selling price of £	$1.40	$43,750 ($1.40 × 31,250 units)
− Purchase price of £	−1.41	−44,063 ($1.41 × 31,250 units)
+ Premium received	+.012	+375 ($.012 × 31,250 units)
= Net profit	$.002	$62 ($.002 × 31,250 units)

As a second example, assume the following information:

- Call option premium on Canadian dollars (C$) = $.01 per unit.
- Strike price = $.70.
- One Canadian dollar option contract represents C$50,000.

A speculator who had purchased this call option decided to exercise the option shortly before the expiration date, when the spot rate reached $.74. The speculator immediately sold the Canadian dollars in the spot market. Given this information, the net profit to the speculator is computed as follows:

	Per Unit	Per Contract
Selling price of C$	$.74	$37,000 ($.74 × 50,000 units)
− Purchase price of C$	−.70	−35,000 ($.70 × 50,000 units)
− Premium paid for option	−.01	−500 ($.01 × 50,000 units)
= Net profit	$.03	$1,500 ($.03 × 50,000 units)

If the seller of the call option did not obtain Canadian dollars until the option was about to be exercised, the net profit to the seller of the call option was

	Per Unit	Per Contract
Selling price of C$	$.70	$35,000 ($.70 × 50,000 units)
− Purchase price of C$	−.74	−37,000 ($.74 × 50,000 units)
+ Premium received	+.01	+500 ($.01 × 50,000 units)
= Net profit	−$.03	−$1,500 (−$.03 × 50,000 units)

When brokerage fees are ignored, the currency call purchaser's gain will be the seller's loss. The currency call purchaser's expenses represent the seller's revenues, and the purchaser's revenues represent the seller's expenses. Yet, because it is possible for purchasers and sellers of options to close out their positions, the relationship described here will not hold unless both parties begin and close out their positions at the same time.

An owner of a currency option may simply sell the option to someone else before the expiration date rather than exercising it. The owner can still earn profits since the option premium changes over time, reflecting the probability that the option can be exercised and the potential profit from exercising it.

Break-Even Point from Speculation. The purchaser of a call option will break even if the revenue from selling the currency equals the payments for (1) the currency (at the strike price) and (2) the option premium. In other words, regardless of the number of units in a contract, a purchaser will break even if the spot rate at which the currency is sold is equal to the strike price plus the option premium.

EXAMPLE Based on the information in the previous example, the strike price is $.70 and the option premium is $.01. Thus, for the purchaser to break even, the spot rate existing at the time the call is exercised must be $.71 ($.70 + $.01). Of course, speculators will not purchase a call option if they think the spot rate will only reach the break-even point and not go higher before the expiration date. Nevertheless, the computation of the break-even point is useful for a speculator deciding whether to purchase a currency call option. ■

Currency Put Options

The owner of a **currency put option** receives the right to sell a currency at a specified price (the strike price) within a specified period of time. As with currency call options, the owner of a put option is not obligated to exercise the option. Therefore, the maximum potential loss to the owner of the put option is the price (or premium) paid for the option contract.

A currency put option is said to be *in the money* when the present exchange rate is less than the strike price, *at the money* when the present exchange rate equals the strike price, and *out of the money* when the present exchange rate exceeds the strike price. For a given currency and expiration date, an in-the-money put option will require a higher premium than options that are at the money or out of the money.

Factors Affecting Currency Put Option Premiums

The put option premium (referred to as P) is primarily influenced by three factors:

$$P = f(S - X, T, \sigma)$$
$$\quad\; - \quad + \; +$$

where $S - X$ represents the difference between the spot exchange rate (S) and the strike or exercise price (X), T represents the time to maturity, and σ represents the volatility of the currency, as measured by the standard deviation of the movements in the currency. The relationships between the put option premium and these factors, which also influence call option premiums as described earlier, are summarized next.

First, the spot rate of a currency relative to the strike price is important. The lower the spot rate relative to the strike price, the more valuable the put option will be, because there is a higher probability that the option will be exercised. Recall that just the opposite relationship held for call options. A second factor influencing the put option premium is the length of time until the expiration date. As with currency call options, the longer the time to expiration, the greater the put option premium will be. A longer period creates a higher probability that the currency will move into a range where it will be feasible to exercise the option (whether it is a put or a call). These relationships can be verified by assessing quotations of put option premiums for a specified currency. A third factor that influences the put option premium is the variability of a currency. As with currency call options, the greater the variability, the greater the put option premium will be, again reflecting a higher probability that the option may be exercised.

Hedging with Currency Put Options

Corporations with open positions in foreign currencies can use currency put options in some cases to cover these positions.

EXAMPLE Assume Duluth Co. has exported products to Canada and invoiced the products in Canadian dollars (at the request of the Canadian importers). Duluth is concerned that the Canadian dollars it is receiving will depreciate over time. To insulate itself against possible depreciation, Duluth purchases Canadian dollar put options, which entitle it to sell Canadian dollars at the specified strike price. In essence, Duluth locks in the minimum rate at which it can exchange Canadian dollars for U.S. dollars over a specified period of time. If the Canadian dollar appreciates over this time period, Duluth can let the put options expire and sell the Canadian dollars it receives at the prevailing spot rate. ■

At a given point in time, some put options are deep out of the money, meaning that the prevailing exchange rate is high above the exercise price. These options are cheaper (have a lower premium), as they are unlikely to be exercised because their exercise price is too low. At the same time, other put options have an exercise price that is currently above the prevailing exchange rate and are therefore more likely to be exercised. Consequently, these options are more expensive.

EXAMPLE Cisco Systems weighs the tradeoff when using put options to hedge the remittance of earnings from Europe to the United States. It can create a hedge that is cheap, but the options can be exercised only if the currency's spot rate declines substantially. Alternatively, Cisco can create a hedge that can be exercised at a more favorable exchange rate, but it must pay a higher premium for the options. If Cisco's goal in using put options is simply to prevent a major loss if the currency weakens substantially, it may be willing to use an inexpensive put option (low exercise price, low premium). However, if its goal is to ensure that the currency can be exchanged at a more favorable exchange rate, Cisco will use a more expensive put option (high exercise price, high premium). By selecting currency options with an exercise price and premium that fits their objectives, Cisco and other MNCs can increase their value. ■

Speculating with Currency Put Options

Individuals may speculate with currency put options based on their expectations of the future movements in a particular currency. For example, speculators who expect that the British pound will depreciate can purchase British pound put options, which

will entitle them to sell British pounds at a specified strike price. If the pound's spot rate depreciates as expected, the speculators can then purchase pounds at the spot rate and exercise their put options by selling these pounds at the strike price.

Speculators can also attempt to profit from selling currency put options. The seller of such options is obligated to purchase the specified currency at the strike price from the owner who exercises the put option. Speculators who believe the currency will appreciate (or at least will not depreciate) may sell a currency put option. If the currency appreciates over the entire period, the option will not be exercised. This is an ideal situation for put option sellers since they keep the premiums received when selling the options and bear no cost.

The net profit to a speculator from trading put options on a currency is based on a comparison of the exercise price at which the currency can be sold versus the purchase price of the currency and the premium paid for the put option.

EXAMPLE A put option contract on British pounds specifies the following information:

- Put option premium on British pound (£) = $.04 per unit.
- Strike price = $1.40.
- One option contract represents £31,250.

A speculator who had purchased this put option decided to exercise the option shortly before the expiration date, when the spot rate of the pound was $1.30. The speculator purchased the pounds in the spot market at that time. Given this information, the net profit to the purchaser of the put option is calculated as follows:

	Per Unit	Per Contract
Selling price of £	$1.40	$43,750 ($1.40 × 31,250 units)
− Purchase price of £	−1.30	−40,625 ($1.30 × 31,250 units)
− Premium paid for option	−.04	−1,250 ($.04 × 31,250 units)
= Net profit	$.06	$ 1,875 ($.06 × 31,250 units)

Assuming that the seller of the put option sold the pounds received immediately after the option was exercised, the net profit to the seller of the put option is calculated as follows:

	Per Unit	Per Contract
Selling price of £	$1.30	$40,625 ($1.30 × 31,250 units)
− Purchase price of £	−1.40	−43,750 ($1.40 × 31,250 units)
+ Premium received	+.04	+1,250 ($.04 × 31,250 units)
= Net profit	−$.06	−$1,875 (−$.06 × 31,250 units)

The seller of the put options could simply refrain from selling the pounds (after being forced to buy them at $1.40 per pound) until the spot rate of the pound rises. However, there is no guarantee that the pound will reverse its direction and begin to appreciate. The seller's net loss could potentially be greater if the pound's spot rate continued to fall, unless the pounds were sold immediately.

Whatever an owner of a put option gains, the seller loses, and vice versa. This relationship would hold if brokerage costs did not exist and if the buyer and seller of

options entered and closed their positions at the same time. Brokerage fees for currency options exist, however, and are very similar in magnitude to those of currency futures contracts.

Speculating with Combined Put and Call Options. For volatile currencies, one possible speculative strategy is to create a **straddle,** which uses both a put option and a call option at the same exercise price. This may seem unusual because owning a put option is appropriate for expectations that the currency will depreciate while owning a call option is appropriate for expectations that the currency will appreciate. However, it is possible that the currency will depreciate (at which time the put is exercised) and then reverse direction and appreciate (allowing for profits when exercising the call).

Also, a speculator might anticipate that a currency will be substantially affected by current economic events yet be uncertain of the exact way it will be affected. By purchasing a put option and a call option, the speculator will gain if the currency moves substantially in either direction. Although two options are purchased and only one is exercised, the gains could more than offset the costs.

HTTP://

http://www.phlx.com/products/currency/currency.html
Contract specifications and volume information for the currency options contracts that are traded on the Philadelphia Stock Exchange.

Currency Options Market Efficiency. If the currency options market is efficient, the premiums on currency options properly reflect all available information. Under these conditions, it may be difficult for speculators to consistently generate abnormal profits when speculating in this market. Research has found that the currency options market is efficient after controlling for transaction costs. Although some trading strategies could have generated abnormal gains in specific periods, they would have generated large losses if implemented in other periods. It is difficult to know which strategy would generate abnormal profits in future periods.

Contingency Graphs for Currency Options

A contingency graph for currency options illustrates the potential gain or loss for various exchange rate scenarios.

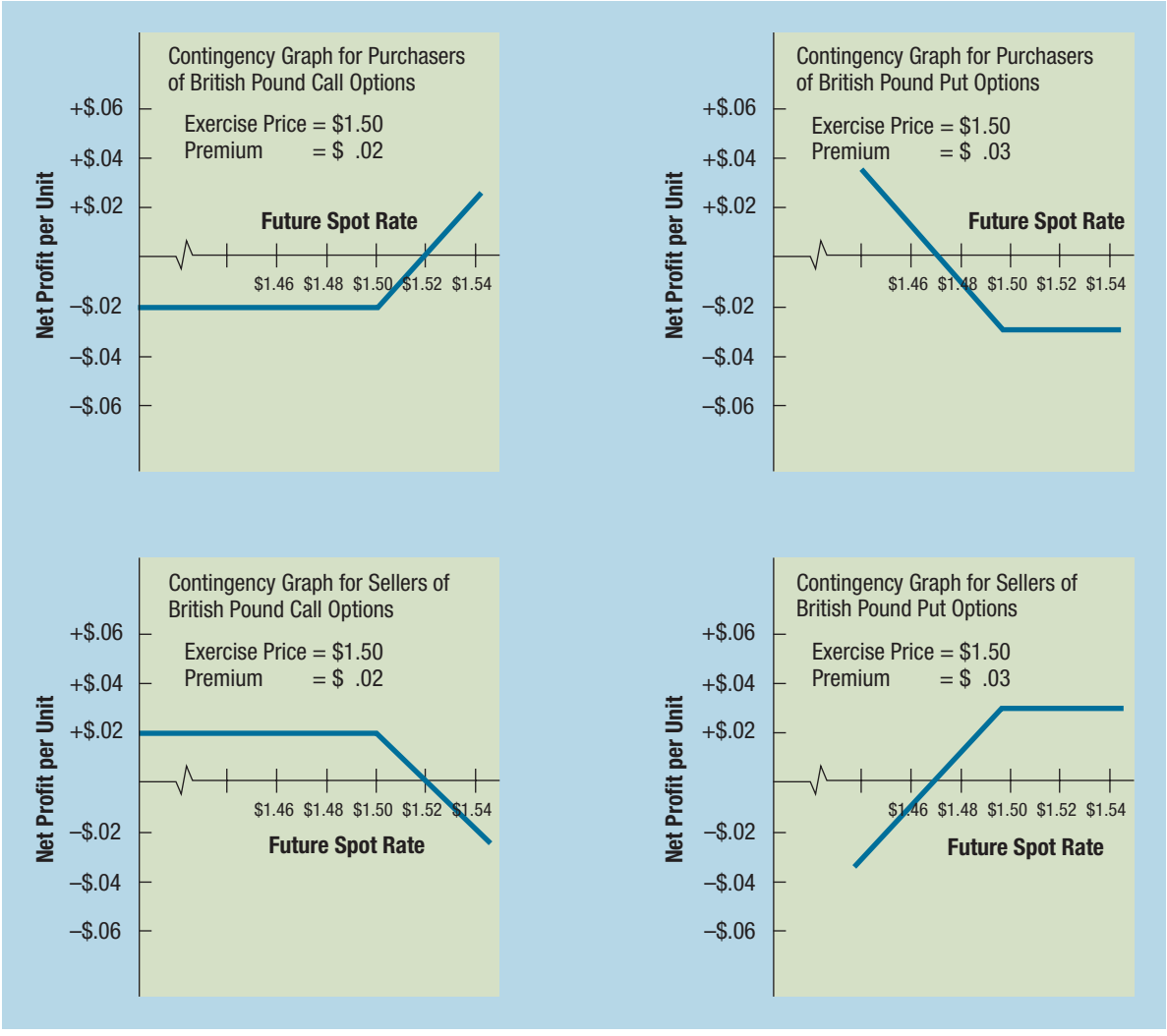
Contingency Graph for a Purchaser of a Call Option

A contingency graph for a purchaser of a call option compares the price paid for the call option to potential payoffs to be received with various exchange rate scenarios.

EXAMPLE A British pound call option is available, with a strike price of $1.50 and a call premium of $.02. The speculator plans to exercise the option on the expiration date (if appropriate at that time) and then immediately sell the pounds received in the spot market. Under these conditions, a **contingency graph** can be created to measure the profit or loss per unit (see the upper-left graph in Exhibit 5.6). Notice that if the future spot rate is $1.50 or less, the net gain per unit is −$.02 (ignoring transaction costs). This represents the loss of the premium per unit paid for the option, as the option would not be exercised. At $1.51, $.01 per unit would be earned by exercising the option, but considering the $.02 premium paid, the net gain would be −$.01.

At $1.52, $.02 per unit would be earned by exercising the option, which would offset the $.02 premium per unit. This is the break-even point. At any rate above this point, the gain from exercising the option would more than offset the premium, resulting in a positive net gain. The maximum loss to the speculator in this example is the premium paid for the option. ■

Exhibit 5.6 Contingency Graphs for Currency Options



Contingency Graph for a Seller of a Call Option

A contingency graph for the seller of a call option compares the premium received from selling a call option to the potential payoffs made to the buyer of the call option for various exchange rate scenarios.

EXAMPLE The lower-left graph shown in Exhibit 5.6 provides a contingency graph for a speculator who sold the call option described in the previous example. It assumes that this seller would purchase the pounds in the spot market just as the option was exercised (ignoring transaction costs). At future spot rates of less than $1.50, the net gain to the seller would be the premium of $.02 per unit, as the option would not have been exercised. If the future spot rate is $1.51, the seller would lose $.01 per unit on the option transaction (paying $1.51 for pounds in the spot market and selling pounds for $1.50 to fulfill the exercise request). Yet, this loss would be more than offset by the premium of $.02 per unit received, resulting in a net gain of $.01 per unit.

The break-even point is at $1.52, and the net gain to the seller of a call option becomes negative at all future spot rates higher than that point. Notice that the contingency graphs for the buyer and seller of this call option are mirror images of one another. ■

Contingency Graph for a Buyer of a Put Option

A contingency graph for a buyer of a put option compares the premium paid for the put option to potential payoffs received for various exchange rate scenarios.

EXAMPLE The upper-right graph in Exhibit 5.6 shows the net gains to a buyer of a British pound put option with an exercise price of $1.50 and a premium of $.03 per unit. If the future spot rate is above $1.50, the option will not be exercised. At a future spot rate of $1.48, the put option will be exercised. However, considering the premium of $.03 per unit, there will be a net loss of $.01 per unit. The break-even point in this example is $1.47, since this is the future spot rate that will generate $.03 per unit from exercising the option to offset the $.03 premium. At any future spot rates of less than $1.47, the buyer of the put option will earn a positive net gain. ■

Contingency Graph for a Seller of a Put Option

A contingency graph for the seller of this put option compares the premium received from selling the option to the possible payoffs made to the buyer of the put option for various exchange rate scenarios. The graph is shown in the lower-right graph in Exhibit 5.6. It is the mirror image of the contingency graph for the buyer of a put option.

For various reasons, an option buyer's net gain will not always represent an option seller's net loss. The buyer may be using call options to hedge a foreign currency, rather than to speculate. In this case, the buyer does not evaluate the options position taken by measuring a net gain or loss; the option is used simply for protection. In addition, sellers of call options on a currency in which they currently maintain a position will not need to purchase the currency at the time an option is exercised. They can simply liquidate their position in order to provide the currency to the person exercising the option.

GOVERNANCE

Should an MNC's Managers Use Currency Derivatives to Speculate?

Managers of MNCs may be tempted to use currency derivatives for speculation. However, such actions are not consistent with the general operations of an MNC. In addition, this may increase the risk of the MNC and adversely affect its reputation. Some creditors may no longer lend funds to an MNC if they believe the funds may be used to gamble in the foreign exchange market. An MNC's board of directors governs the actions of managers and can impose guidelines that prevent speculation with currency derivatives. In addition, it can ensure that the structure of management compensation would not reward managers that speculated in currency derivatives. ■

Conditional Currency Options

A currency option can be structured with a conditional premium, meaning that the premium paid for the option is conditioned on the actual movement in the currency's value over the period of concern.

EXAMPLE Jensen Co., a U.S.-based MNC, needs to sell British pounds that it will receive in 60 days. It can negotiate a traditional currency put option on pounds in which the exercise price is $1.70 and the premium is $.02 per unit.

Alternatively, it can negotiate a conditional currency option with a commercial bank, which has an exercise price of $1.70 and a so-called trigger of $1.74. If the pound's value falls below the exercise price by the expiration date, Jensen will exercise the option, thereby receiving $1.70 per pound, and it will not have to pay a premium for the option.

If the pound's value is between the exercise price ($1.70) and the trigger ($1.74), the option will not be exercised, and Jensen will not need to pay a premium. If the pound's value exceeds the trigger of $1.74, Jensen will pay a premium of $.04 per unit. Notice that this premium may be higher than the premium that would be paid for a basic put option. Jensen may not mind this outcome, however, because it will be receiving a high dollar amount from converting its pound receivables in the spot market.

Jensen must determine whether the potential advantage of the conditional option (avoiding the payment of a premium under some conditions) outweighs the potential disadvantage (paying a higher premium than the premium for a traditional put option on British pounds).

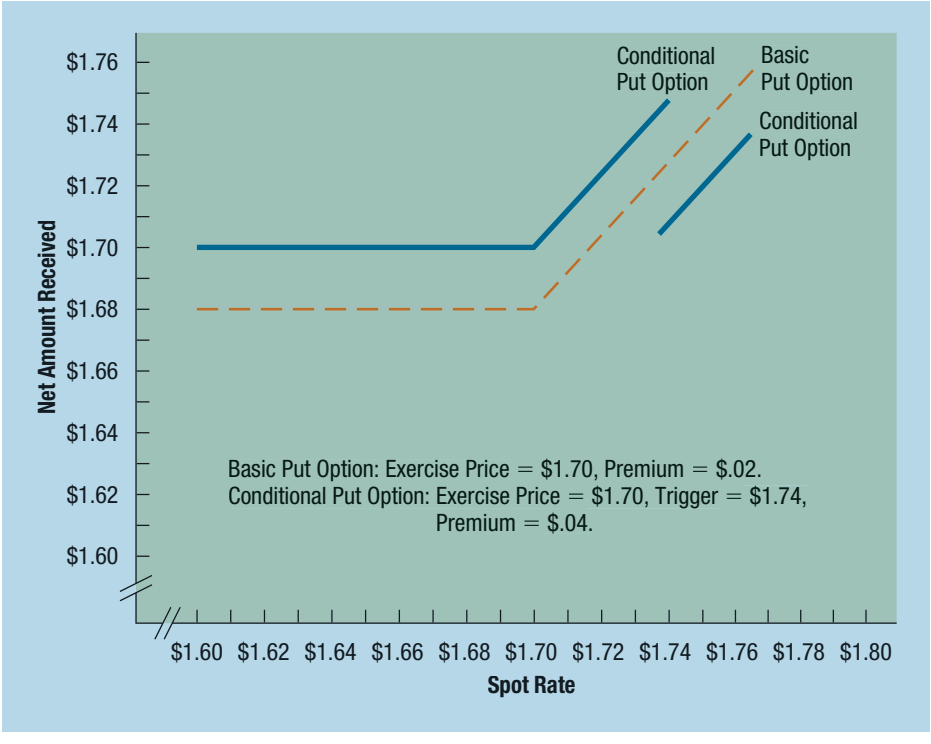
The potential advantage and disadvantage are illustrated in Exhibit 5.7. At exchange rates less than or equal to the trigger level ($1.74), the conditional option results in a larger payment to Jensen by the amount of the premium that would have been paid for the basic option. Conversely, at exchange rates above the trigger level, the conditional option results in a lower payment to Jensen, as its premium of $.04 exceeds the premium of $.02 per unit paid on a basic option. ■

The choice of a basic option versus a conditional option is dependent on expectations of the currency's exchange rate over the period of concern. A firm that was very confident that the pound's value would not exceed $1.74 in the previous example would prefer the conditional currency option.

Conditional currency options are also available for U.S. firms that need to purchase a foreign currency in the near future.

EXAMPLE A conditional call option on pounds may specify an exercise price of $1.70 and a trigger of $1.67. If the pound's value remains above the trigger of the call option, a premium will not have to be paid for the call option. However, if the pound's value falls below the trigger, a large premium (such as $.04 per unit) will be required. Some conditional options require a

Exhibit 5.7 Comparison of Conditional and Basic Currency Options



premium if the trigger is reached anytime up until the expiration date; others require a premium only if the exchange rate is beyond the trigger as of the expiration date. ■

Firms also use various combinations of currency options. For example, a firm may purchase a currency call option to hedge payables and finance the purchase of the call option by selling a put option on the same currency.

European Currency Options

The discussion of currency options up to this point has dealt solely with American-style options. European-style currency options are also available for speculating and hedging in the foreign exchange market. They are similar to American-style options except that they must be exercised on the expiration date if they are to be exercised at all. Consequently, they do not offer as much flexibility; however, this is not relevant to some situations. For example, firms that purchase options to hedge future foreign currency cash flows will probably not desire to exercise their options before the expiration date anyway. If European-style options are available for the same expiration date as American-style options and can be purchased for a slightly lower premium, some corporations may prefer them for hedging.

SUMMARY

■ A forward contract specifies a standard volume of a particular currency to be exchanged on a particular date. Such a contract can be purchased by a firm to hedge payables or sold by a firm to hedge receivables.

■ A currency futures contract can be purchased by speculators who expect the currency to appreciate. Conversely, it can be sold by speculators who expect that currency to depreciate. If the currency depreciates, the value of the futures contract declines, allowing those speculators to benefit when they close out their positions.

■ Futures contracts on a particular currency can be purchased by corporations that have payables in that currency and wish to hedge against the possible appreciation of that currency. Conversely, these contracts can be sold by corporations that have receivables in that currency and wish to hedge against the possible depreciation of that currency.

■ Currency options are classified as call options or put options. Call options allow the right to purchase a specified currency at a specified exchange rate by a specified expiration date. Put options allow the right to sell a specified currency at a specified exchange rate by a specified expiration date.

■ Call options on a specific currency can be purchased by speculators who expect that currency to appreciate. Put options on a specific currency can be purchased by speculators who expect that currency to depreciate.

■ Currency call options are commonly purchased by corporations that have payables in a currency that is expected to appreciate. Currency put options are commonly purchased by corporations that have receivables in a currency that is expected to depreciate.

POINT COUNTER-POINT

Should Speculators Use Currency Futures or Options?

Point Speculators should use currency futures because they can avoid a substantial premium. To the extent that they are willing to speculate, they must have confidence in their expectations. If they have sufficient confidence in their expectations, they should bet on their expectations without having to pay a large

premium to cover themselves if they are wrong. If they do not have confidence in their expectations, they should not speculate at all.

Counter-Point Speculators should use currency options to fit the degree of their confidence. For example, if they are very confident that a currency will appreciate substantially, but want to limit their investment, they can buy deep out-of-the-money options. These options have a high exercise price but a low premium and therefore require a small investment. Alternatively, they can buy options that have a lower exercise price (higher premium), which will likely generate a greater return if the currency appreciates. Speculation involves risk. Speculators must recognize that their expectations may be wrong. While options require a premium, the premium is worthwhile to limit the potential downside risk. Options enable speculators to select the degree of downside risk that they are willing to tolerate.

Who Is Correct? Use the Internet to learn more about this issue. Which argument do you support? Offer your own opinion on this issue.

SELF TEST

Answers are provided in Appendix A at the back of the text.

1. A call option on Canadian dollars with a strike price of $.60 is purchased by a speculator for a premium of $.06 per unit. Assume there are 50,000 units in this option contract. If the Canadian dollar's spot rate is $.65 at the time the option is exercised, what is the net profit per unit and for one contract to the speculator? What would the spot rate need to be at the time the option is exercised for the speculator to break even? What is the net profit per unit to the seller of this option?
2. A put option on Australian dollars with a strike price of $.80 is purchased by a speculator for a premium of $.02. If the Australian dollar's spot rate is $.74 on the expiration date, should the speculator exercise the option on this date or let the option expire? What is the net profit per unit to the speculator? What is the net profit per unit to the seller of this put option?
3. Longer-term currency options are becoming more popular for hedging exchange rate risk. Why do you think some firms decide to hedge by using other techniques instead of purchasing long-term currency options?

QUESTIONS AND APPLICATIONS

1. **Forward versus Futures Contracts.** Compare and contrast forward and futures contracts.
2. **Using Currency Futures.**
   a. How can currency futures be used by corporations?
   b. How can currency futures be used by speculators?
3. **Currency Options.** Differentiate between a currency call option and a currency put option.
4. **Forward Premium.** Compute the forward discount or premium for the Mexican peso whose 90-day forward rate is $.102 and spot rate is $.10. State whether your answer is a discount or premium.
5. **Effects of a Forward Contract.** How can a forward contract backfire?
6. **Hedging with Currency Options.** When would a U.S. firm consider purchasing a call option on euros for hedging? When would a U.S. firm consider purchasing a put option on euros for hedging?
7. **Speculating with Currency Options.** When should a speculator purchase a call option on Australian dollars? When should a speculator purchase a put option on Australian dollars?
8. **Currency Call Option Premiums.** List the factors that affect currency call option premiums and briefly explain the relationship that exists for each. Do you think an at-the-money call option in euros has a higher or lower premium than an at-the-money call option in Mexican pesos (assuming the expiration date and the total dollar value represented by each option are the same for both options)?
9. **Currency Put Option Premiums.** List the factors that affect currency put option premiums and briefly explain the relationship that exists for each.
10. **Speculating with Currency Call Options.** Randy Rudecki purchased a call option on British pounds for $.02 per unit. The strike price was $1.45, and the spot rate at the time the option was exercised

was $1.46. Assume there are 31,250 units in a British pound option. What was Randy's net profit on this option?

11. **Speculating with Currency Put Options.** Alice Duever purchased a put option on British pounds for $.04 per unit. The strike price was $1.80, and the spot rate at the time the pound option was exercised was $1.59. Assume there are 31,250 units in a British pound option. What was Alice's net profit on the option?

12. **Selling Currency Call Options.** Mike Suerth sold a call option on Canadian dollars for $.01 per unit. The strike price was $.76, and the spot rate at the time the option was exercised was $.82. Assume Mike did not obtain Canadian dollars until the option was exercised. Also assume that there are 50,000 units in a Canadian dollar option. What was Mike's net profit on the call option?

13. **Selling Currency Put Options.** Brian Tull sold a put option on Canadian dollars for $.03 per unit. The strike price was $.75, and the spot rate at the time the option was exercised was $.72. Assume Brian immediately sold off the Canadian dollars received when the option was exercised. Also assume that there are 50,000 units in a Canadian dollar option. What was Brian's net profit on the put option?

14. **Forward versus Currency Option Contracts.** What are the advantages and disadvantages to a U.S. corporation that uses currency options on euros rather than a forward contract on euros to hedge its exposure in euros? Explain why an MNC may use forward contracts to hedge committed transactions and use currency options to hedge contracts that are anticipated but not committed. Why might forward contracts be advantageous for committed transactions, and currency options be advantageous for anticipated transactions?

15. **Speculating with Currency Futures.** Assume that the euro's spot rate has moved in cycles over time. How might you try to use futures contracts on euros to capitalize on this tendency? How could you determine whether such a strategy would have been profitable in previous periods?

16. **Hedging with Currency Derivatives.** Assume that the transactions listed in the first column of the table below are anticipated by U.S. firms that have no other foreign transactions. Place an "X" in the table wherever you see possible ways to hedge each of the transactions.

17. **Price Movements of Currency Futures.** Assume that on November 1, the spot rate of the British pound was $1.58 and the price on a December futures contract was $1.59. Assume that the pound depreciated during November so that by November 30 it was worth $1.51.

    a. What do you think happened to the futures price over the month of November? Why?

    b. If you had known that this would occur, would you have purchased or sold a December futures contract in pounds on November 1? Explain.

18. **Speculating with Currency Futures.** Assume that a March futures contract on Mexican pesos was available in January for $.09 per unit. Also assume that forward contracts were available for the same settlement date at a price of $.092 per peso. How could speculators capitalize on this situation, assuming zero transaction costs? How would such speculative

	Forward Contract		Futures Contract		Options Contract	
	Forward Purchase	Forward Sale	Buy Futures	Sell Futures	Purchase a Call	Purchase a Put
a. Georgetown Co. plans to purchase Japanese goods denominated in yen.						
b. Harvard, Inc., will sell goods to Japan, denominated in yen.						
c. Yale Corp. has a subsidiary in Australia that will be remitting funds to the U.S. parent.						
d. Brown, Inc., needs to pay off existing loans that are denominated in Canadian dollars.						
e. Princeton Co. may purchase a company in Japan in the near future (but the deal may not go through).						

activity affect the difference between the forward contract price and the futures price?

19. **Speculating with Currency Call Options.** LSU Corp. purchased Canadian dollar call options for speculative purposes. If these options are exercised, LSU will immediately sell the Canadian dollars in the spot market. Each option was purchased for a premium of $.03 per unit, with an exercise price of $.75. LSU plans to wait until the expiration date before deciding whether to exercise the options. Of course, LSU will exercise the options at that time only if it is feasible to do so. In the following table, fill in the net profit (or loss) per unit to LSU Corp. based on the listed possible spot rates of the Canadian dollar on the expiration date.

Possible Spot Rate of Canadian Dollar on Expiration Date	Net Profit (Loss) per Unit to LSU Corp.
$.76	
.78	
.80	
.82	
.85	
.87	

20. **Speculating with Currency Put Options.** Auburn Co. has purchased Canadian dollar put options for speculative purposes. Each option was purchased for a premium of $.02 per unit, with an exercise price of $.86 per unit. Auburn Co. will purchase the Canadian dollars just before it exercises the options (if it is feasible to exercise the options). It plans to wait until the expiration date before deciding whether to exercise the options. In the following table, fill in the net profit (or loss) per unit to Auburn Co. based on the listed possible spot rates of the Canadian dollar on the expiration date.

Possible Spot Rate of Canadian Dollar on Expiration Date	Net Profit (Loss) per Unit to Auburn Co.
$.76	
.79	
.84	
.87	
.89	
.91	

21. **Speculating with Currency Call Options.** Bama Corp. has sold British pound call options for speculative purposes. The option premium was $.06 per unit, and the exercise price was $1.58. Bama will purchase the pounds on the day the options are exercised (if the options are exercised) in order to fulfill its obligation. In the following table, fill in the net profit (or loss) to Bama Corp. if the listed spot rate exists at the time the purchaser of the call options considers exercising them.

Possible Spot Rate at the Time Purchaser of Call Options Considers Exercising Them	Net Profit (Loss) per Unit to Bama Corp.
$1.53	
1.55	
1.57	
1.60	
1.62	
1.64	
1.68	

22. **Speculating with Currency Put Options.** Bulldog, Inc., has sold Australian dollar put options at a premium of $.01 per unit, and an exercise price of $.76 per unit. It has forecasted the Australian dollar's lowest level over the period of concern as shown in the following table. Determine the net profit (or loss) per unit to Bulldog, Inc., if each level occurs and the put options are exercised at that time.

Possible Value of Australian Dollar	Net Profit (Loss) to Bulldog, Inc. If Value Occurs
$.72	
.73	
.74	
.75	
.76	

23. **Hedging with Currency Derivatives.** A U.S. professional football team plans to play an exhibition game in the United Kingdom next year. Assume that all expenses will be paid by the British government, and that the team will receive a check for 1 million pounds. The team anticipates that the pound will depreciate substantially by the scheduled date of the game. In addition, the National Football League must approve the deal,

and approval (or disapproval) will not occur for 3 months. How can the team hedge its position? What is there to lose by waiting 3 months to see if the exhibition game is approved before hedging?

Advanced Questions

24. **Risk of Currency Futures.** Currency futures markets are commonly used as a means of capitalizing on shifts in currency values, because the value of a futures contract tends to move in line with the change in the corresponding currency value. Recently, many currencies appreciated against the dollar. Most speculators anticipated that these currencies would continue to strengthen and took large buy positions in currency futures. However, the Fed intervened in the foreign exchange market by immediately selling foreign currencies in exchange for dollars, causing an abrupt decline in the values of foreign currencies (as the dollar strengthened). Participants that had purchased currency futures contracts incurred large losses. One floor broker responded to the effects of the Fed's intervention by immediately selling 300 futures contracts on British pounds (with a value of about $30 million). Such actions caused even more panic in the futures market.

    a. Explain why the central bank's intervention caused such panic among currency futures traders with buy positions.

    b. Explain why the floor broker's willingness to sell 300 pound futures contracts at the going market rate aroused such concern. What might this action signal to other brokers?

    c. Explain why speculators with short (sell) positions could benefit as a result of the central bank's intervention.

    d. Some traders with buy positions may have responded immediately to the central bank's intervention by selling futures contracts. Why would some speculators with buy positions leave their positions unchanged or even increase their positions by purchasing more futures contracts in response to the central bank's intervention?

25. **Estimating Profits from Currency Futures and Options.** One year ago, you sold a put option on 100,000 euros with an expiration date of one year. You received a premium on the put option of $.04 per unit. The exercise price was $1.22. Assume that one year ago, the spot rate of the euro was $1.20, the one-year forward rate exhibited a discount of 2 percent, and the one-year futures price was the same as the one-year forward rate. From one year ago to today, the euro depreciated against the dollar by 4 percent. Today the put option will be exercised (if it is feasible for the buyer to do so).

    a. Determine the total dollar amount of your profit or loss from your position in the put option.

    b. Now assume that instead of taking a position in the put option one year ago, you sold a futures contract on 100,000 euros with a settlement date of one year. Determine the total dollar amount of your profit or loss.

26. **Impact of Information on Currency Futures and Options Prices.** Myrtle Beach Co. purchases imports that have a price of 400,000 Singapore dollars, and it has to pay for the imports in 90 days. It can purchase a 90-day forward contract on Singapore dollars at $.50 or purchase a call option contract on Singapore dollars with an exercise price of $.50. This morning, the spot rate of the Singapore dollar was $.50. At noon, the central bank of Singapore raised interest rates, while there was no change in interest rates in the United States. These actions immediately increased the degree of uncertainty surrounding the future value of the Singapore dollar over the next 3 months. The Singapore dollar's spot rate remained at $.50 throughout the day.

    a. Myrtle Beach Co. is convinced that the Singapore dollar will definitely appreciate substantially over the next 90 days. Would a call option hedge or forward hedge be more appropriate given its opinion?

    b. Assume that Myrtle Beach uses a currency options contract to hedge rather than a forward contract. If Myrtle Beach Co. purchased a currency call option contract at the money on Singapore dollars this afternoon, would its total U.S. dollar cash outflows be MORE THAN, LESS THAN, or THE SAME AS the total U.S. dollar cash outflows if it had purchased a currency call option contract at the money this morning? Explain.

27. **Currency Straddles.** Reska, Inc., has constructed a long euro straddle. A call option on euros with an exercise price of $1.10 has a premium of $.025 per unit. A euro put option has a premium of $.017 per unit. Some possible euro values at option expiration are shown in the following table. (See Appendix B in this chapter.)

	Value of Euro at Option Expiration			
	$.90	$1.05	$1.50	$2.00
Call				
Put				
Net				

    a. Complete the worksheet and determine the net profit per unit to Reska, Inc., for each possible future spot rate.

b. Determine the break-even point(s) of the long straddle. What are the break-even points of a short straddle using these options?

28. **Currency Straddles.** Refer to the previous question, but assume that the call and put option premiums are $.02 per unit and $.015 per unit, respectively. (See Appendix B in this chapter.)

    a. Construct a contingency graph for a long euro straddle.

    b. Construct a contingency graph for a short euro straddle.

29. **Currency Option Contingency Graphs.** (See Appendix B in this chapter.) The current spot rate of the Singapore dollar (S$) is $.50. The following option information is available:

    - Call option premium on Singapore dollar (S$) = $.015.
    - Put option premium on Singapore dollar (S$) = $.009.
    - Call and put option strike price = $.55.
    - One option contract represents S$70,000.

    Construct a contingency graph for a short straddle using these options.

30. **Speculating with Currency Straddles.** Maggie Hawthorne is a currency speculator. She has noticed that recently the euro has appreciated substantially against the U.S. dollar. The current exchange rate of the euro is $1.15. After reading a variety of articles on the subject, she believes that the euro will continue to fluctuate substantially in the months to come. Although most forecasters believe that the euro will depreciate against the dollar in the near future, Maggie thinks that there is also a good possibility of further appreciation. Currently, a call option on euros is available with an exercise price of $1.17 and a premium of $.04. A euro put option with an exercise price of $1.17 and a premium of $.03 is also available. (See Appendix B in this chapter.)

    a. Describe how Maggie could use straddles to speculate on the euro's value.

    b. At option expiration, the value of the euro is $1.30. What is Maggie's total profit or loss from a long straddle position?

    c. What is Maggie's total profit or loss from a long straddle position if the value of the euro is $1.05 at option expiration?

    d. What is Maggie's total profit or loss from a long straddle position if the value of the euro at option expiration is still $1.15?

    e. Given your answers to the questions above, when is it advantageous for a speculator to engage in a long straddle? When is it advantageous to engage in a short straddle?

31. **Currency Strangles.** (See Appendix B in this chapter.) Assume the following options are currently available for British pounds (£):

    - Call option premium on British pounds = $.04 per unit.
    - Put option premium on British pounds = $.03 per unit.
    - Call option strike price = $1.56.
    - Put option strike price = $1.53.
    - One option contract represents £31,250.

    a. Construct a worksheet for a long strangle using these options.

    b. Determine the break-even point(s) for a strangle.

    c. If the spot price of the pound at option expiration is $1.55, what is the total profit or loss to the strangle buyer?

    d. If the spot price of the pound at option expiration is $1.50, what is the total profit or loss to the strangle writer?

32. **Currency Straddles.** Refer to the previous question, but assume that the call and put option premiums are $.035 per unit and $.025 per unit, respectively. (See Appendix B in this chapter.)

    a. Construct a contingency graph for a long pound straddle.

    b. Construct a contingency graph for a short pound straddle.

33. **Currency Strangles.** The following information is currently available for Canadian dollar (C$) options (see Appendix B in this chapter):

    - Put option exercise price = $.75.
    - Put option premium = $.014 per unit.
    - Call option exercise price = $.76.
    - Call option premium = $.01 per unit.
    - One option contract represents C$50,000.

    a. What is the maximum possible gain the purchaser of a strangle can achieve using these options?

    b. What is the maximum possible loss the writer of a strangle can incur?

    c. Locate the break-even point(s) of the strangle.

34. **Currency Strangles.** For the following options available on Australian dollars (A$), construct a worksheet and contingency graph for a long strangle. Locate the break-even points for this strangle. (See Appendix B in this chapter.)

    - Put option strike price = $.67.
    - Call option strike price = $.65.
    - Put option premium = $.01 per unit.
    - Call option premium = $.02 per unit.

35. **Speculating with Currency Options.** Barry Egan is a currency speculator. Barry believes that the Japanese yen will fluctuate widely against the U.S. dollar in the coming month. Currently, one-month call options on Japanese yen (¥) are available with a strike price of $.0085 and a premium of $.0007 per unit. One-month put options on Japanese yen are available with a strike price of $.0084 and a premium of $.0005 per unit. One option contract on Japanese yen contains ¥6.25 million. (See Appendix B in this chapter.)

    a. Describe how Barry Egan could utilize these options to speculate on the movement of the Japanese yen.

    b. Assume Barry decides to construct a long strangle in yen. What are the break-even points of this strangle?

    c. What is Barry's total profit or loss if the value of the yen in one month is $.0070?

    d. What is Barry's total profit or loss if the value of the yen in one month is $.0090?

36. **Currency Bull Spreads and Bear Spreads.** A call option on British pounds (£) exists with a strike price of $1.56 and a premium of $.08 per unit. Another call option on British pounds has a strike price of $1.59 and a premium of $.06 per unit. (See Appendix B in this chapter.)

    a. Complete the worksheet for a bull spread below.

	Value of British Pound at Option Expiration			
	$1.50	$1.56	$1.59	$1.65
Call @ $1.56				
Call @ $1.59				
Net				

    b. What is the break-even point for this bull spread?

    c. What is the maximum profit of this bull spread? What is the maximum loss?

    d. If the British pound spot rate is $1.58 at option expiration, what is the total profit or loss for the bull spread?

    e. If the British pound spot rate is $1.55 at option expiration, what is the total profit or loss for a bear spread?

37. **Bull Spreads and Bear Spreads.** Two British pound (£) put options are available with exercise prices of $1.60 and $1.62. The premiums associated with these options are $.03 and $.04 per unit, respectively. (See Appendix B in this chapter.)

    a. Describe how a bull spread can be constructed using these put options. What is the difference between using put options versus call options to construct a bull spread?

    b. Complete the following worksheet.

	Value of British Pound at Option Expiration			
	$1.55	$1.60	$1.62	$1.67
Put @ $1.60				
Put @ $1.62				
Net				

    c. At option expiration, the spot rate of the pound is $1.60. What is the bull spreader's total gain or loss?

    d. At option expiration, the spot rate of the pound is $1.58. What is the bear spreader's total gain or loss?

38. **Profits from Using Currency Options and Futures.** On July 2, the 2-month futures rate of the Mexican peso contained a 2 percent discount (unannualized). There was a call option on pesos with an exercise price that was equal to the spot rate. There was also a put option on pesos with an exercise price equal to the spot rate. The premium on each of these options was 3 percent of the spot rate at that time. On September 2, the option expired. Go to http://www.oanda.com (or any website that has foreign exchange rate quotations) and determine the direct quote of the Mexican peso. You exercised the option on this date if it was feasible to do so.

    a. What was your net profit per unit if you had purchased the call option?

    b. What was your net profit per unit if you had purchased the put option?

    c. What was your net profit per unit if you had purchased a futures contract on July 2 that had a settlement date of September 2?

    d. What was your net profit per unit if you sold a futures contract on July 2 that had a settlement date of September 2?

Discussion in the Boardroom

This exercise can be found in Appendix E at the back of this textbook.

Running Your Own MNC

This exercise can be found on the Xtra! website at http://maduraxtra.swlearning.com.

BLADES, INC. CASE

Use of Currency Derivative Instruments

Blades, Inc., needs to order supplies 2 months ahead of the delivery date. It is considering an order from a Japanese supplier that requires a payment of 12.5 million yen payable as of the delivery date. Blades has two choices:

- Purchase two call options contracts (since each option contract represents 6,250,000 yen).
- Purchase one futures contract (which represents 12.5 million yen).

The futures price on yen has historically exhibited a slight discount from the existing spot rate. However, the firm would like to use currency options to hedge payables in Japanese yen for transactions 2 months in advance. Blades would prefer hedging its yen payable position because it is uncomfortable leaving the position open given the historical volatility of the yen. Nevertheless, the firm would be willing to remain unhedged if the yen becomes more stable someday.

Ben Holt, Blades' chief financial officer (CFO), prefers the flexibility that options offer over forward contracts or futures contracts because he can let the options expire if the yen depreciates. He would like to use an exercise price that is about 5 percent above the existing spot rate to ensure that Blades will have to pay no more than 5 percent above the existing spot rate for a transaction 2 months beyond its order date, as long as the option premium is no more than 1.6 percent of the price it would have to pay per unit when exercising the option.

In general, options on the yen have required a premium of about 1.5 percent of the total transaction amount that would be paid if the option is exercised. For example, recently the yen spot rate was $.0072, and the firm purchased a call option with an exercise price of $.00756, which is 5 percent above the existing spot rate. The premium for this option was $.0001134, which is 1.5 percent of the price to be paid per yen if the option is exercised.

A recent event caused more uncertainty about the yen's future value, although it did not affect the spot rate or the forward or futures rate of the yen. Specifically, the yen's spot rate was still $.0072, but the option premium for a call option with an exercise price of $.00756 was now $.0001512. An alternative call option is available with an expiration date of 2 months from now; it has a premium of $.0001134 (which is the size of the premium that would have existed for the option desired before the event), but it is for a call option with an exercise price of $.00792.

The table below summarizes the option and futures information available to Blades:

	Before Event	After Event	
Spot rate	$.0072	$.0072	$.0072
Option Information			
Exercise price ($)	$.00756	$.00756	$.00792
Exercise price (% above spot)	5%	5%	10%
Option premium per yen ($)	$.0001134	$.0001512	$.0001134
Option premium (% of exercise price)	1.5%	2.0%	1.5%
Total premium ($)	$1,417.50	$1,890.00	$1,417.50
Amount paid for yen if option is exercised (not including premium)	$94,500	$94,500	$99,000
Futures Contract Information			
Futures price	$.006912	$.006912	

As an analyst for Blades, you have been asked to offer insight on how to hedge. Use a spreadsheet to support your analysis of questions 4 and 6.

1. If Blades uses call options to hedge its yen payables, should it use the call option with the exercise price of $.00756 or the call option with the exercise price of $.00792? Describe the tradeoff.
2. Should Blades allow its yen position to be unhedged? Describe the tradeoff.
3. Assume there are speculators who attempt to capitalize on their expectation of the yen's movement over the 2 months between the order and delivery dates by either buying or selling yen futures now and buying or selling yen at the future spot rate. Given this information, what is the *expectation* on the order date of the yen spot rate by the delivery date? (Your answer should consist of one number.)
4. Assume that the firm shares the market consensus of the future yen spot rate. Given this expectation and given that the firm makes a decision (i.e.,

option, futures contract, remain unhedged) purely on a cost basis, what would be its optimal choice?

5. Will the choice you made as to the optimal hedging strategy in question 4 definitely turn out to be the lowest-cost alternative in terms of actual costs incurred? Why or why not?
6. Now assume that you have determined that the historical standard deviation of the yen is about $.0005. Based on your assessment, you believe it is highly unlikely that the future spot rate will be more than two standard deviations above the expected spot rate by the delivery date. Also assume that the futures price remains at its current level of $.006912. Based on this expectation of the future spot rate, what is the optimal hedge for the firm?

SMALL BUSINESS DILEMMA

Use of Currency Futures and Options by the Sports Exports Company

The Sports Exports Company receives British pounds each month as payment for the footballs that it exports. It anticipates that the pound will depreciate over time against the U.S. dollar.

1. How can the Sports Exports Company use currency futures contracts to hedge against exchange rate risk? Are there any limitations of using currency futures contracts that would prevent the Sports Exports Company from locking in a specific exchange rate at which it can sell all the pounds it expects to receive in each of the upcoming months?
2. How can the Sports Exports Company use currency options to hedge against exchange rate risk? Are there any limitations of using currency options contracts that would prevent the Sports Exports Company from locking in a specific exchange rate at which it can sell all the pounds it expects to receive in each of the upcoming months?
3. Jim Logan, owner of the Sports Exports Company, is concerned that the pound may depreciate substantially over the next month, but he also believes that the pound could appreciate substantially if specific situations occur. Should Jim use currency futures or currency options to hedge the exchange rate risk? Is there any disadvantage of selecting this method for hedging?

INTERNET/EXCEL EXERCISES

The website of the Chicago Mercantile Exchange provides information about currency futures and options. Its address is **http://www.cme.com**.

1. Use this website to review the prevailing prices of currency futures contracts. Do today's futures prices (for contracts with the closest settlement date) generally reflect an increase or decrease from the day before? Is there any news today that might explain the change in the futures prices?
2. Does it appear that futures prices among currencies (for the closest settlement date) are changing in the same direction? Explain.
3. If you purchase a British pound futures contract with the closest settlement date, what is the futures price? Given that a contract is based on 62,500 pounds, what is the dollar amount you will need at the settlement date to fulfill the contract?
4. Go to **http://www.phlx.com/products** and obtain the money currency option quotations for the Canadian dollar (the symbol is XCD) and the euro (symbol is XEU) for a similar expiration date. Which currency option has a larger premium? Explain your results.

APPENDIX 5A

Currency Option Pricing

The premiums paid for currency options depend on various factors that must be monitored when anticipating future movements in currency option premiums. Since participants in the currency options market typically take positions based on their expectations of how the premiums will change over time, they can benefit from understanding how options are priced.

Boundary Conditions

The first step in pricing currency options is to recognize boundary conditions that force the option premium to be within lower and upper bounds.

Lower Bounds

The call option premium (C) has a lower bound of at least zero or the spread between the underlying spot exchange rate (S) and the exercise price (X), whichever is greater, as shown below:

$$C = \text{MAX}(0, S - X)$$

This floor is enforced by arbitrage restrictions. For example, assume that the premium on a British pound call option is $.01, while the spot rate of the pound is $1.62 and the exercise price is $1.60. In this example, the spread ($S - X$) exceeds the call premium, which would allow for arbitrage. One could purchase the call option for $.01 per unit, immediately exercise the option at $1.60 per pound, and then sell the pounds in the spot market for $1.62 per unit. This would generate an immediate profit of $.01 per unit. Arbitrage would continue until the market forces realigned the spread ($S - X$) to be less than or equal to the call premium.

The put option premium (P) has a lower bound of zero or the spread between the exercise price (X) and the underlying spot exchange rate (S), whichever is greater, as shown below:

$$P = \text{MAX}(0, X - S)$$

This floor is also enforced by arbitrage restrictions. For example, assume that the premium on a British pound put option is $.02, while the spot rate of the pound is $1.60 and the exercise price is $1.63. One could purchase the pound put option for $.02 per unit, purchase pounds in the spot market at $1.60, and immediately exercise the option by selling the pounds at $1.63 per unit. This would generate an immediate profit of $.01 per unit. Arbitrage would continue until the market forces realigned the spread ($X - S$) to be less than or equal to the put premium.

Upper Bounds

The upper bound for a call option premium is equal to the spot exchange rate (S):

$$C = S$$

If the call option premium ever exceeds the spot exchange rate, one could engage in arbitrage by selling call options for a higher price per unit than the cost of purchasing the underlying currency. Even if those call options are exercised, one could provide the currency that was purchased earlier (the call option was covered). The arbitrage profit in this example is the difference between the amount received when selling the premium and the cost of purchasing the currency in the spot market. Arbitrage would occur until the call option's premium was less than or equal to the spot rate.

The upper bound for a put option is equal to the option's exercise price (X):

$$P = X$$

If the put option premium ever exceeds the exercise price, one could engage in arbitrage by selling put options. Even if the put options are exercised, the proceeds received from selling the put options exceed the price paid (which is the exercise price) at the time of exercise.

Given these boundaries that are enforced by arbitrage, option premiums lie within these boundaries.

Application of Pricing Models

HTTP://

http://www.ozforex.com.au/cgi-bin/optionscalc.asp
Estimates the price of currency options based on input provided.

Although boundary conditions can be used to determine the possible range for a currency option's premium, they do not precisely indicate the appropriate premium for the option. However, pricing models have been developed to price currency options. Based on information about an option (such as the exercise price and time to maturity) and about the currency (such as its spot rate, standard deviation, and interest rate), pricing models can derive the premium on a currency option. The currency option pricing model of Biger and Hull[1] is shown below:

$$C = e^{-r^*T} S \cdot N(d_1) - e^{-rT} X \cdot N(d_1 - \sigma\sqrt{T})$$

where

$$d_1 = \{\ln(S/X) + [r - r^* + (\sigma^2/2)]T\}/\sigma\sqrt{T}$$

C = price of the currency call option
S = underlying spot exchange rate
X = exercise price
r = U.S. riskless rate of interest
r^* = foreign riskless rate of interest
σ = instantaneous standard deviation of the return on a holding of foreign currency
T = option's time maturity expressed as a fraction of a year
$N(\cdot)$ = standard normal cumulative distribution function

This equation is based on the stock option pricing model (OPM) when allowing for continuous dividends. Since the interest gained on holding a foreign security (r^*) is equivalent to a continuously paid dividend on a stock share, this version of the OPM holds completely. The key transformation in adapting the stock OPM to value currency options is the substitution of exchange rates for stock prices. Thus,

[1] Nahum Biger and John Hull, "The Valuation of Currency Options," *Financial Management* (Spring 1983), 24–28.

the percentage change of exchange rates is assumed to follow a diffusion process with constant mean and variance.

Bodurtha and Courtadon[2] have tested the predictive ability of the currency option pricing model. They computed pricing errors from the model using 3,326 call options. The model's average percentage pricing error for call options was −6.90 percent, which is smaller than the corresponding error reported for the dividend-adjusted Black-Scholes stock OPM. Hence, the currency option pricing model has been more accurate than the counterpart stock OPM.

The model developed by Biger and Hull is sometimes referred to as the European model because it does not account for early exercise. European currency options do not allow for early exercise (before the expiration date), while American currency options do allow for early exercise. The extra flexibility of American currency options may justify a higher premium on American currency options than on European currency options with similar characteristics. However, there is not a closed-form model for pricing American currency options. Although various techniques are used to price American currency options, the European model is commonly applied to price American currency options because it can be just as accurate.

Bodurtha and Courtadon found that the application of an American currency options pricing model does not improve predictive accuracy. Their average percentage pricing error was −7.07 percent for all sample call options when using the American model.

Given all other parameters, the currency option pricing model can be used to impute the standard deviation σ. This implied parameter represents the option's market assessment of currency volatility over the life of the option.

Pricing Currency Put Options According to Put-Call Parity

Given the premium of a European call option (called C), the premium for a European put option (called P) on the same currency and same exercise price (X) can be derived from put-call parity, as shown below:

$$P = C + Xe^{-rt} - Se^{-r^*T}$$

where

r = U.S. riskless rate of interest
r^* = foreign riskless rate of interest
T = option's time to maturity expressed as a fraction of the year

If the actual put option premium is less than what is suggested by the put-call parity equation above, arbitrage can be conducted. Specifically, one could (1) buy the put option, (2) sell the call option, and (3) buy the underlying currency. The purchases are financed with the proceeds from selling the call option and from borrowing at the rate r. Meanwhile, the foreign currency that was purchased can be deposited to earn the foreign rate r^*. Regardless of the scenario for the path of the currency's exchange rate movement over the life of the option, the arbitrage will result in a profit. First, if the exchange rate is equal to the exercise price such that each option expires worthless, the foreign currency can be converted in the spot market to dollars, and this amount will exceed the amount required to repay the loan. Second, if the foreign currency appreciates and therefore exceeds the exercise price, there will be a loss from the call option being exercised. Although the put option will expire, the foreign currency will be converted in the spot market to dollars, and this amount will exceed the amount

[2] James Bodurtha and Georges Courtadon, "Tests of an American Option Pricing Model on the Foreign Currency Options Market," *Journal of Financial and Quantitative Analysis* (June 1987): 153–168.

required to repay the loan and the amount of the loss on the call option. Third, if the foreign currency depreciates and therefore is below the exercise price, the amount received from exercising the put option plus the amount received from converting the foreign currency to dollars will exceed the amount required to repay the loan. Since the arbitrage generates a profit under any exchange rate scenario, it will force an adjustment in the option premiums so that put-call parity is no longer violated.

If the actual put option premium is more than what is suggested by put-call parity, arbitrage would again be possible. The arbitrage strategy would be the reverse of that used when the actual put option premium was less than what is suggested by put-call parity (as just described). The arbitrage would force an adjustment in option premiums so that put-call parity is no longer violated. The arbitrage that can be applied when there is a violation of put-call parity on American currency options differs slightly from the arbitrage applicable to European currency options. Nevertheless, the concept still holds that the premium of a currency put option can be determined according to the premium of a call option on the same currency and the same exercise price.

APPENDIX 5B

Currency Option Combinations

In addition to the basic call and put options just discussed, a variety of currency option combinations are available to the currency speculator and hedger. A **currency option combination** uses simultaneous call and put option positions to construct a unique position to suit the hedger's or speculator's needs. A currency option combination may include both long and short positions and will itself be either long or short. Typically, a currency option combination will result in a unique contingency graph.

Currency option combinations can be used both to hedge cash inflows and outflows denominated in a foreign currency and to speculate on the future movement of a foreign currency. More specifically, both MNCs and individual speculators can construct a currency option combination to accommodate expectations of either appreciating or depreciating foreign currencies.

In this appendix, two of the most popular currency option combinations are discussed. These are **straddles** and **strangles.** For each of these combinations, the following topics will be discussed:

- The composition of the combination
- The worksheet and contingency graph for the long combination
- The worksheet and contingency graph for the short combination
- Uses of the combination to speculate on the movement of a foreign currency

The two main types of currency option combinations are discussed next.

Currency Straddles

Long Currency Straddle

To construct a long straddle in a foreign currency, an MNC or individual would buy (take a long position in) both a call option and a put option for that currency; the call and the put option have the same expiration date and striking price.

When constructing a long straddle, the buyer purchases both the right to buy the foreign currency and the right to sell the foreign currency. Since the call option will become profitable if the foreign currency appreciates, and the put option will become profitable if the foreign currency depreciates, a long straddle becomes profitable when the foreign currency *either* appreciates or depreciates. Obviously, this is a huge advantage for the individual or entity that constructs a long straddle, since it appears that it would benefit from the position as long as the foreign currency exchange rate does not remain constant. The disadvantage of a long straddle position is that it is expensive to construct, because it involves the purchase of two separate options, each of

which requires payment of the option premium. Therefore, a long straddle becomes profitable only if the foreign currency appreciates or depreciates substantially.

Long Currency Straddle Worksheet. To determine the profit or loss associated with a long straddle (or any combination), it is easiest to first construct a profit or loss worksheet for several possible currency values at option expiration. The worksheet can be set up to show each individual option position and the net position. The worksheet will also help in constructing a contingency graph for the combination.

EXAMPLE Put and call options are available for euros (€) with the following information:

- Call option premium on euro = $.03 per unit.
- Put option premium on euro = $.02 per unit.
- Strike price = $1.05.
- One option contract represents €62,500.

To construct a long straddle, the buyer would purchase both a euro call and a euro put option, paying $.03 + $.02 = $.05 per unit. If the value of the euro at option expiration is above the strike price of $1.05, the call option is in the money, but the put option is out of the money. Conversely, if the value of the euro at option expiration is below $1.05, the put option is in the money, but the call option is out of the money.

A possible worksheet for the long straddle that illustrates the profitability of the individual components is shown below:

	Value of Euro at Option Expiration					
	$.95	$1.00	$1.05	$1.10	$1.15	$1.20
Own a call	−$.03	−$.03	−$.03	+$.02	+$.07	+$.12
Own a put	+$.08	+$.03	−$.02	−$.02	−$.02	−$.02
Net	+$.05	$.00	−$.05	$.00	+$.05	+$.10

Long Currency Straddle Contingency Graph. A contingency graph for the long currency straddle is shown in Exhibit 5B.1. This graph includes more extreme possible outcomes than are shown in the table. Either the call or put option on the foreign currency will be in the money at option expiration as long as the foreign currency value at option expiration differs from the strike price.

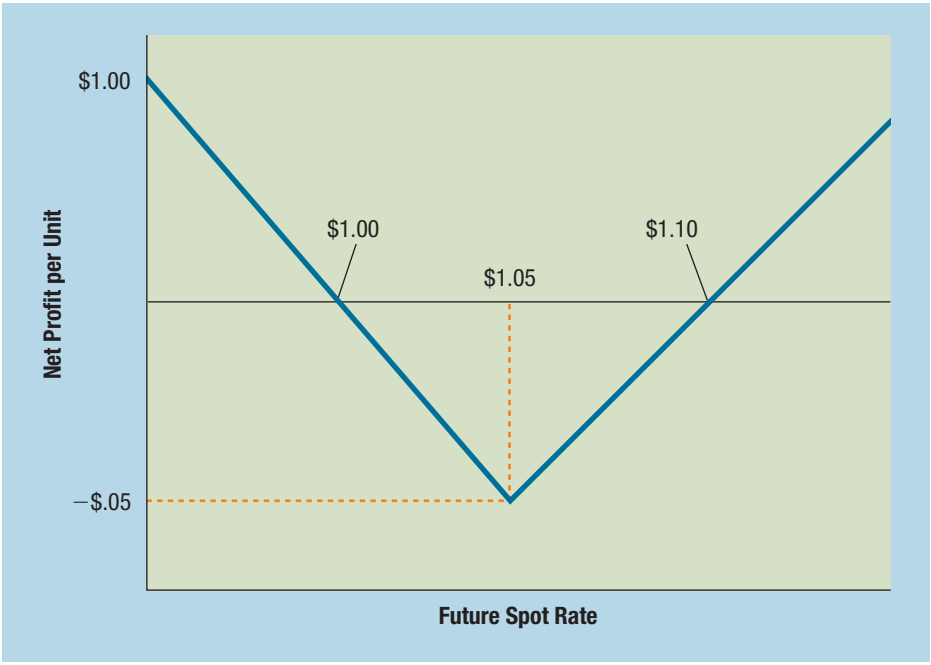
There are two break-even points for a long straddle position—one below the strike price and one above the strike price. The lower break-even point is equal to the strike price less both premiums; the higher break-even point is equal to the strike price plus both premiums. Thus, for the above example, the two break-even points are located at $1.00 = $1.05 − $.05 and at $1.10 = $1.05 + $.05.

The maximum loss for the long straddle in the example occurs at a euro value at option expiration equal to the strike price, when both options are at the money. At that point, the straddle buyer would lose both option premiums. The maximum loss for the straddle buyer is thus equal to $.05 = $.03 + $.02.

Short Currency Straddle

Constructing a short straddle in a foreign currency involves selling (taking a short position in) both a call option and a put option for that currency. As in a long straddle, the call and put option have the same expiration date and strike price.

Exhibit 5B.1 Contingency Graph for a Long Currency Straddle



The advantage of a short straddle is that it provides the option writer with income from two separate options. The disadvantage is the possibility of substantial losses if the underlying currency moves substantially away from the strike price.

Short Currency Straddle Worksheet and Contingency Graph. A short straddle results in a worksheet and contingency graph that are exactly opposite to those of a long straddle.

EXAMPLE Assuming the same information as in the previous example, a short straddle would involve writing both a call option on euros and a put option on euros. A possible worksheet for the resulting short straddle is shown below:

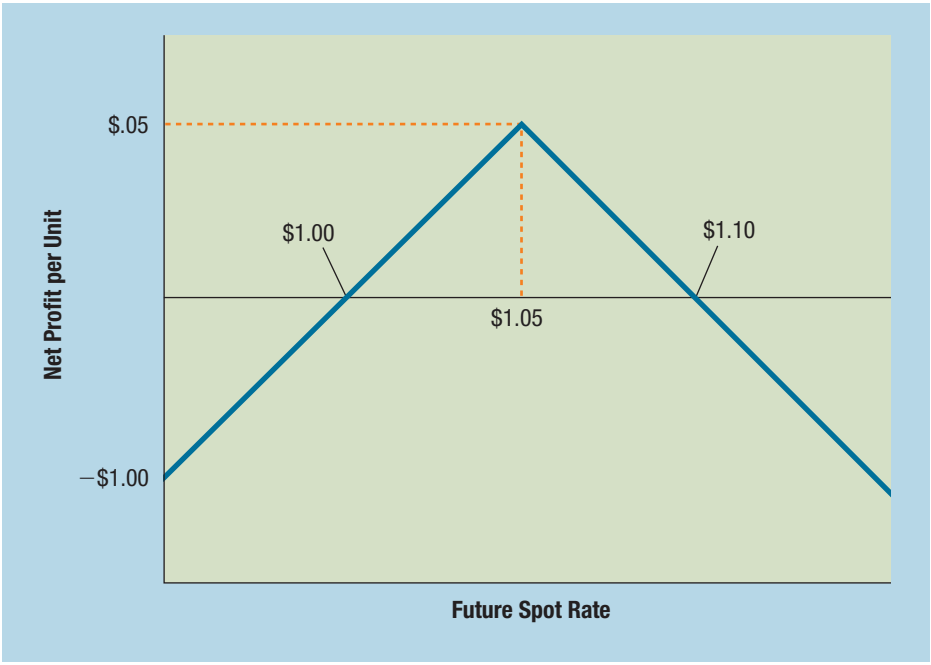
	Value of Euro at Option Expiration					
	$.95	**$1.00**	**$1.05**	**$1.10**	**$1.15**	**$1.20**
Sell a call	+$.03	+$.03	+$.03	−$.02	−$.07	−$.12
Sell a put	−$.08	−$.03	+$.02	+$.02	+$.02	+$.02
Net	−$.05	$.00	+$.05	$.00	−$.05	−$.10

The worksheet also illustrates that there are two break-even points for a short straddle position—one below the strike price and one above the strike price. The lower break-even point is equal to the strike price less both premiums; the higher break-even point is equal to the strike price plus both premiums. Thus, the two break-even points are located at $1.00 = $1.05 − $.05 and at $1.10 = $1.05 + $.05. This is the same relationship as for the long straddle position.

The maximum gain occurs at a euro value at option expiration equal to the strike price of $1.05 and is equal to the sum of the two option premiums ($.03 + $.02 = $.05).

The resulting contingency graph is shown in Exhibit 5B.2. ■

Exhibit 5B.2 Contingency Graph for a Short Currency Straddle



Speculating with Currency Straddles

Individuals can speculate using currency straddles based on their expectations of the future movement in a particular foreign currency. For example, speculators who expect that the British pound will appreciate or depreciate substantially can buy a straddle. If the pound appreciates substantially, the speculator will let the put option expire and exercise the call option. If the pound depreciates substantially, the speculator will let the call option expire and exercise the put option.

Speculators may also profit from short straddles. The writer of a short straddle believes that the value of the underlying currency will remain close to the exercise price until option expiration. If the value of the underlying currency is equal to the strike price at option expiration, the straddle writer would collect premiums from both options. However, this is a rather risky position; if the currency appreciates or depreciates substantially, the straddle writer will lose money. If the currency appreciates substantially, the straddle writer will have to sell the currency for the strike price, since the call option will be exercised. If the currency depreciates substantially, the straddle writer has to buy the currency for the strike price, since the put option will be exercised.

EXAMPLE Call and put option contracts on British pounds (£) are available with the following information:

- Call option premium on British pounds = $.035.
- Put option premium on British pounds = $.025.
- Strike price = $1.50.
- One option contract represents £31,250.

At expiration, the spot rate of the pound is $1.40. A speculator who had bought a straddle will therefore exercise the put option but let the call option expire. Therefore, the speculator will

buy pounds at the prevailing spot rate and sell them for the exercise price. Given this information, the net profit to the straddle buyer is calculated as follows:

	Per Unit	Per Contract
Selling price of £	+$1.50	$46,875 ($1.50 × 31,250 units)
− Purchase price of £	−1.40	−43,750 ($1.40 × 31,250 units)
− Premium paid for call option	−.035	−1,093.75 ($.035 × 31,250 units)
− Premium paid for put option	−.025	−781.25 ($.025 × 31,250 units)
= Net profit	$.04	$1,250 ($.04 × 31,250 units)

The straddle writer will have to purchase pounds for the exercise price. Assuming the speculator immediately sells the acquired pounds at the prevailing spot rate, the net profit to the straddle writer will be:

	Per Unit	Per Contract
Selling price of £	+$1.40	$43,750 ($1.40 × 31,250 units)
− Purchase price of £	−1.50	−46,875 ($1.50 × 31,250 units)
+ Premium received for call option	+.035	1,093.75 ($.035 × 31,250 units)
+ Premium received for put option	+.025	781.25 ($.025 × 31,250 units)
= Net profit	−$.04	−$1,250 ($.04 × 31,250 units)

As with an individual short put position, the seller of the straddle could simply refrain from selling the pounds (after being forced to buy them at the exercise price of $1.50) until the spot rate of the pound rises. However, there is no guarantee that the pound will appreciate in the near future. ■

Note from the above example and discussion that the straddle writer gains what the straddle buyer loses, and vice versa. Consequently, the straddle writer's gain or loss is the straddle buyer's loss or gain. Thus, the same relationship that applies to individual call and put options also applies to option combinations.

Currency Strangles

Currency strangles are very similar to currency straddles, with one important difference: The call and put options of the underlying foreign currency have different exercise prices. Nevertheless, the underlying security and the expiration date for the call and put options are identical.

Long Currency Strangle

Since the call and put options used in a strangle can have different exercise prices, a long strangle can be constructed in a variety of ways. For example, a strangle could be constructed in which the call option has a higher exercise price than the put option and vice versa. The most common type of strangle, and the focus of this section, is a strangle that involves buying a put option with a lower strike price than the call option that is purchased. To construct a long strangle in a foreign currency, an MNC or individual would thus take a long position in a call option and a long position in a put option for that currency. The call option has the higher exercise price.

An advantage of a long strangle relative to a comparable long straddle is that it is cheaper to construct. From previous sections, recall that there is an inverse relationship between the spot price of the currency relative to the strike price and the call option premium: the lower the spot price relative to the strike price, the lower the option premium will be. Therefore, if a long strangle involves purchasing a call option with a relatively high exercise price, it should be cheaper to construct than a comparable straddle, everything else being equal.

The disadvantage of a strangle relative to a straddle is that the underlying currency has to fluctuate more prior to expiration. As with a long straddle, the reason for constructing a long strangle is the expectation of a substantial currency fluctuation in either direction prior to the expiration date. However, since the two options involved in a strangle have different exercise prices, the underlying currency has to fluctuate to a larger extent before the strangle is in the money at future spot prices.

Long Currency Strangle Worksheet. The worksheet for a long currency strangle is similar to the worksheet for a long currency straddle, as the following example shows.

EXAMPLE Put and call options are available for euros (€) with the following information:

- Call option premium on euro = $.025 per unit.
- Put option premium on euro = $.02 per unit.
- Call option strike price = $1.15.
- Put option strike price = $1.05.
- One option contract represents €62,500.

Note that this example is almost identical to the earlier straddle example, except that the call option has a higher exercise price than the put option and the call option premium is slightly lower.

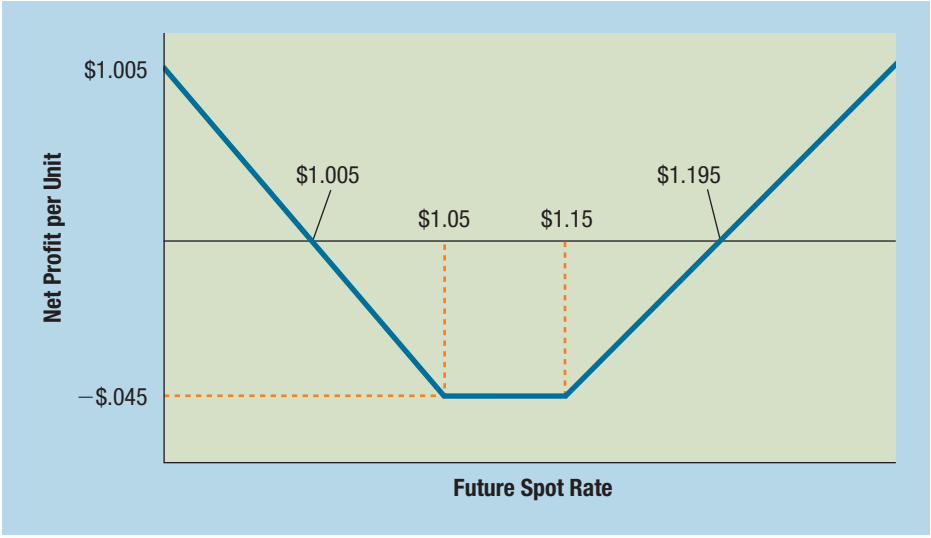
A possible worksheet for the long strangle is shown here:

	Value of Euro at Option Expiration					
	$.95	$1.00	$1.05	$1.10	$1.15	$1.20
Own a call	−$.025	−$.025	−$.025	−$.025	−$.025	+$.025
Own a put	+$.08	+$.03	−$.02	−$.02	−$.02	−$.02
Net	+$.055	+$.005	−$.045	−$.045	−$.045	+$.005

Long Currency Strangle Contingency Graph. Exhibit 5B.3 shows a contingency graph for the long currency strangle. Again, the graph includes more extreme values than are shown in the worksheet. The call option will be in the money when the foreign currency value is higher than its strike price at option expiration, and the put option will be in the money when the foreign currency value is below the put option strike price at option expiration. Thus, the long call position is in the money at euro values above the $1.15 call option exercise price at option expiration. Conversely, the put option is in the money at euro values below the put option exercise price of $1.05.

The two break-even points for a long strangle position are located below the put option premium and above the call option premium. The lower break-even point is equal to the put option strike price less both premiums ($1.005 = $1.05 − $.045); the higher break-even point is equal to the call option strike price plus both premiums ($1.195 = $1.15 + $.045).

Exhibit 5B.3 Contingency Graph for a Long Currency Strangle



The maximum loss for a long strangle occurs at euro values at option expiration between the two strike prices. At any future spot price between the two exercise prices, the straddle buyer would lose both option premiums (−$.045 = −$.25 − $.02).

The contingency graph for the long strangle illustrates that the euro must fluctuate more widely than with a straddle before the position becomes profitable. However, the maximum loss is only $.045 per unit, whereas it was $.05 per unit for the long straddle.

Short Currency Strangle

Analogous to a short currency straddle, a short strangle involves taking a short position in both a call option and a put option for that currency. As with a short straddle, the call and put options have the same expiration date. However, the call option has the higher exercise price in a short strangle.

Relative to a short straddle, the disadvantage of a short strangle is that it provides less income, since the call option premium will be lower, everything else being equal. However, the advantage of a short strangle relative to a short straddle is that the underlying currency has to fluctuate more before the strangle writer is in danger of losing money.

Short Currency Strangle Worksheet and Contingency Graph. The euro example is next used to show that the worksheet and contingency graph for the short strangle are exactly opposite to those of a long strangle.

EXAMPLE Continuing with the information in the preceding example, a short strangle can be constructed by writing a call option on euros and a put option on euros. The resulting worksheet is shown below:

	Value of Euro at Option Expiration					
	$.95	$1.00	$1.05	$1.10	$1.15	$1.20
Sell a call	+$.025	+$.025	+$.025	+$.025	+$.025	−$.025
Sell a put	−$.08	−$.03	+$.02	+$.02	+$.02	+$.02
Net	−$.055	−$.005	+$.045	+$.045	+$.045	−$.005

The table shows that there are two break-even points for the short strangle. The lower break-even point is equal to the put option strike price less both premiums; the higher break-even point is equal to the call option strike price plus both premiums. The two break-even points are thus located at $1.005 = $1.05 − $.045 and at $1.195 = $1.15 + $.045. These break-even points are identical to the break-even points for the long strangle position.

The maximum gain for a short strangle ($.045 = $.025 + $.02) occurs at a value of the euro at option expiration between the two exercise prices.

The short strangle contingency graph is shown in Exhibit 5B.4. ■

Speculating with Currency Strangles

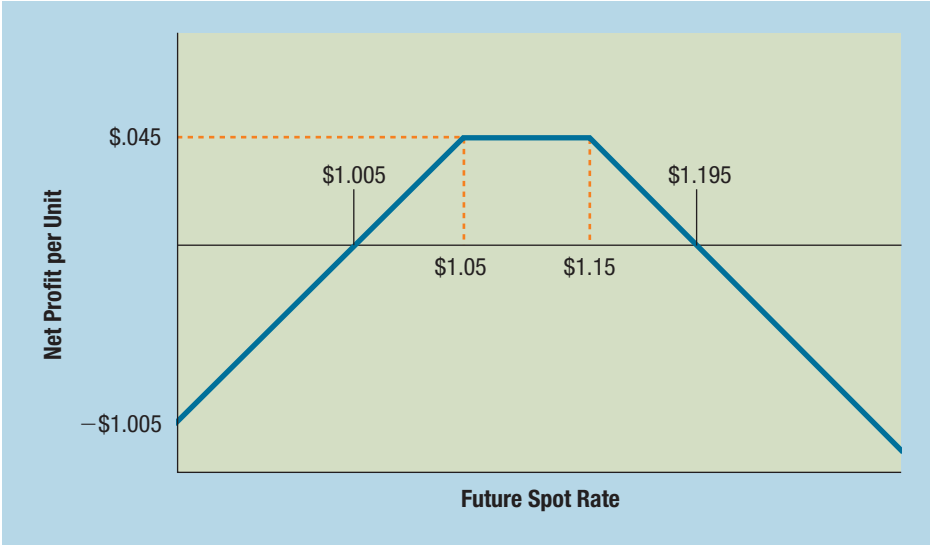
As with straddles, individuals can speculate using currency strangles based on their expectations of the future movement in a particular foreign currency. For instance, speculators who expect that the Swiss franc will appreciate or depreciate substantially can construct a long strangle. Speculators can benefit from short strangles if the future spot price of the underlying currency is between the two exercise prices.

Compared to a straddle, the speculator who buys a strangle believes that the underlying currency will fluctuate even more widely prior to expiration. In return, the speculator pays less to construct the long strangle. A speculator who writes a strangle will receive both option premiums as long as the future spot price is between the two exercise prices. Compared to a straddle, the total amount received from writing the two options is less. However, the range of future spot prices between which no option is exercised is much wider for a short strangle.

EXAMPLE Call and put option contracts on British pounds (£) are available with the following information:

- Call option premium on British pounds = $.030.
- Put option premium on British pounds = $.025.
- Call option strike price = $1.60.
- Put option strike price = $1.50.
- One option contract represents £31,250.

Exhibit 5B.4 Contingency Graph for a Short Currency Strangle



The spot rate of the pound on the expiration date is $1.52. With a long strangle, the speculator will let both options expire, since both the call and the put option are out of the money. Consequently, the strangle buyer will lose both option premiums:

	Per Unit	Per Contract
− Premium paid for call option	−$.030	−$937.50 ($.030 × 31,250 units)
− Premium paid for put option	−.025	−781.25 ($.025 × 31,250 units)
= Net profit	−$.055	−$1,718.75 (−$.055 × 31,250 units)

The straddle writer will receive the premiums from both the call and the put option, since neither option will be exercised by its owner:

	Per Unit	Per Contract
+ Premium received for call option	+$.030	$937.50 ($.030 × 31,250 units)
+ Premium received for put option	+.025	781.25 ($.025 × 31,250 units)
= Net profit	+$.055	$1,718.75 ($.055 × 31,250 units)

As with individual call or put positions and with a straddle, the strangle writer's gain or loss is the strangle buyer's loss or gain. ■

Currency Spreads

A variety of currency spreads exist that can be used by both MNCs and individuals to hedge cash inflows or outflows or to profit from an anticipated movement in a foreign currency. This section covers two of the most popular types of spreads: bull spreads and bear spreads. Bull spreads are profitable when a foreign currency appreciates, whereas bear spreads are profitable when a foreign currency depreciates.

Currency Bull Spreads with Call Options

A currency bull spread is constructed by buying a call option for a particular underlying currency and simultaneously writing a call option for the same currency with a higher exercise price. A bull spread can also be constructed using currency put options, as will be discussed shortly.

With a bull spread, the spreader believes that the underlying currency will appreciate modestly, but not substantially.

EXAMPLE Assume two call options on Australian dollars (A$) are currently available. The first option has a strike price of $.64 and a premium of $.019. The second option has a strike price of $.65 and a premium of $.015. The bull spreader buys the $.64 option and sells the $.65 option. An option contract on Australian dollars consists of 50,000 units.

Consider the following scenarios:

1. The Australian dollar appreciates to $.645, a spot price between the two exercise prices. The bull spreader will exercise the option he bought. Assuming the bull spreader immediately sells the Australian dollars for the $.645 spot rate after purchasing them for the $.64 exercise price, he will gain the difference. The bull spreader will also collect the premium on the second option he wrote, but that option will not be exercised by the (unknown) buyer:

	Per Unit	Per Contract
Selling price of A$	+$.645	$32,250 ($.645 × 50,000 units)
− Purchase price of A$	−.64	−32,000 ($.64 × 50,000 units)
− Premium paid for call option	−.019	−950 ($.019 × 50,000 units)
+ Premium received for call option	+.015	+750 ($.015 × 50,000 units)
= Net profit	$.001	$50 ($.001 × 50,000 units)

Under this scenario, note that the bull spreader would have incurred a net loss of $.645 − $.64 − $.019 = −$.014/A$ if he had purchased only the first option. By writing the second call option, the spreader increased his net profit by $.015/A$.

2. The Australian dollar appreciates to $.70, a value above the higher exercise price. Under this scenario, the bull spreader will exercise the option he purchased, but the option he wrote will also be exercised by the (unknown) buyer. Assuming the bull spreader immediately sells the Australian dollars purchased with the first option and buys the Australian dollars he has to sell to the second option buyer for the spot rate, he will incur the following cash flows:

	Per Unit	Per Contract
Selling price of A$	+$.70	$35,000 ($.70 × 50,000 units)
− Purchase price of A$	−.64	−32,000 ($.64 × 50,000 units)
− Premium paid for call option	−.019	−950 ($.019 × 50,000 units)
+ Selling price of A$	+$.65	+32,500 ($.65 × 50,000 units)
− Purchase price of A$	−.70	−35,000 ($.70 × 50,000 units)
+ Premium received for call option	+.015	+750 ($.015 × 50,000 units)
= Net profit	$.006	$300 ($.006 × 50,000 units)

The important point to understand here is that the net profit to the bull spreader will remain $.006/A$ no matter how much more the Australian dollar appreciates. This is because the bull spreader will always sell the Australian dollars he purchased with the first option for the spot price and purchase the Australian dollars needed to meet his obligation for the second option. The two effects always cancel out, so the bull spreader will net the difference in the two strike prices less the difference in the two premiums ($.65 − $.64 − $.019 + $.015 = $.006). Therefore, the net profit to the bull spreader will be $.006 per unit at any future spot price above $.65.

Equally important to understand is the tradeoff involved in constructing a bull spread. The bull spreader in effect forgoes the benefit from a large currency appreciation by collecting the premium from writing a currency option with a higher exercise price and ensuring a constant profit at future spot prices above the higher exercise price; if he had not written the second option with the higher exercise price, he would have benefited substantially under this scenario, netting $.70 − $.64 − $.019 = $.041/A$ as a result of exercising the call option with the $.64 strike price. This is the reason the bull spreader expects that the underlying currency will appreciate modestly so that he gains from the option he buys and collects the premium from the option he sells without incurring any opportunity costs.

3. The Australian dollar depreciates to $.62, a value below the lower exercise price. If the future spot price is below the lower exercise price, neither call option will be exercised, as

they are both out of the money. Consequently, the net profit to the bull spreader is the difference between the two option premiums:

	Per Unit	Per Contract
− Premium paid for call option	−$.019	−$950 ($.019 × 50,000 units)
+ Premium received for call option	+.015	+750 ($.015 × 50,000 units)
= Net profit	−$.004	−$200 ($.004 × 50,000 units)

Similar to the scenario where the Australian dollar appreciates modestly between the two exercise prices, the bull spreader's loss in this case is reduced by the premium received from writing the call option with the higher exercise price. ■

Currency Bull Spread Worksheet and Contingency Graph.

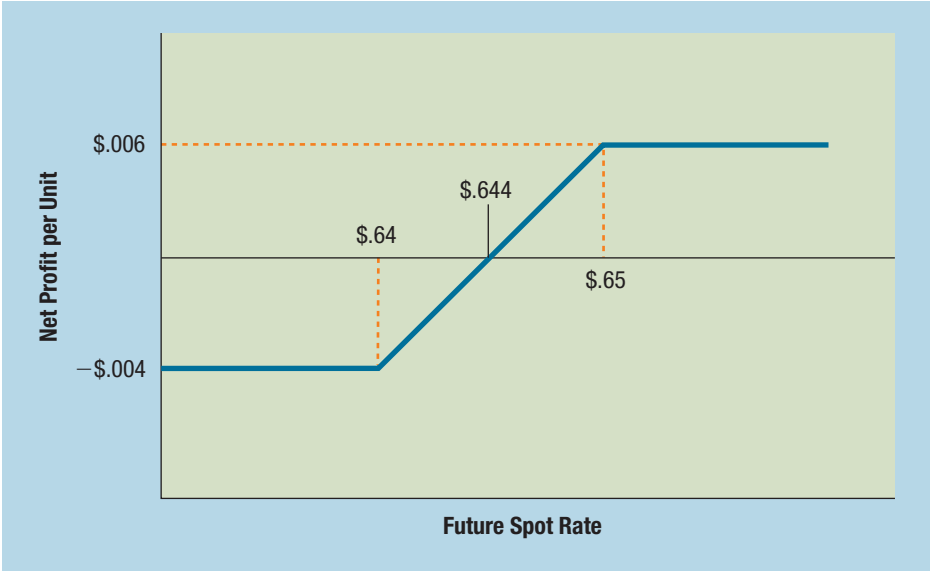
For the Australian dollar example above, a worksheet and contingency graph can be constructed. One possible worksheet is shown below:

	Value of Australian Dollar at Option Expiration				
	$.60	$.64	$.645	$.65	$.70
Buy a call	−$.019	−$.019	−$.014	−$.009	+$.041
Sell a call	+$.015	+$.015	+$.015	+$.015	−$.035
Net	−$.004	−$.004	+$.001	+$.006	+$.006

Exhibit 5B.5 shows the corresponding contingency graph.

The worksheet and contingency graph show that the maximum loss for the bull spreader is limited to the difference between the two option premiums of −$.004 = −$.019 + $.015. This maximum loss occurs at future spot prices equal to the lower strike price or below.

Exhibit 5B.5 Contingency Graph for a Currency Bull Spread



Also note that for a bull spread the gain is limited to the difference between the strike prices less the difference in the option premiums and is equal to $.006 = $.65 − $.64 − $.004. This maximum gain occurs at future spot prices equal to the higher exercise price or above.

The break-even point for the bull spread is located at the lower exercise price plus the difference in the two option premiums and is equal to $.644 = $.64 + $.004.

Currency Bull Spreads with Put Options

As mentioned previously, currency bull spreads can be constructed just as easily with put options as with call options. To construct a put bull spread, the spreader would again buy a put option with a lower exercise price and write a put option with a higher exercise price. The basic arithmetic involved in constructing a put bull spread is thus essentially the same as for a call bull spread, with one important difference, as discussed next.

Recall that there is a positive relationship between the level of the existing spot price relative to the strike price and the call option premium. Consequently, the option with the higher exercise price that is written in a call bull spread will have the lower option premium, everything else being equal. Thus, buying the call option with the lower exercise price and writing the call option with the higher exercise price involves a cash outflow for the bull spreader. For this reason, call bull spreads fall into a broader category of spreads called debit spreads. Also recall that the lower the spot rate relative to the strike price, the higher the put option premium will be. Consequently, the option with the higher strike price that is written in a put bull spread will have the higher option premium, everything else being equal. Thus, buying the put option with the lower exercise price and writing the put option with the higher exercise price in a put bull spread results in a cash inflow for the bull spreader. For this reason, put bull spreads fall into a broader category of spreads called credit spreads.

Speculating with Currency Bull Spreads

The speculator who constructs a currency bull spread trades profit potential for a reduced cost of establishing the position. Ideally, the underlying currency will appreciate to the higher exercise price but not far above it. Although the speculator would still realize the maximum gain of the bull spread in this case, he or she would incur significant opportunity costs if the underlying currency appreciates much above the higher exercise price. Speculating with currency bull spreads is appropriate for currencies that are expected to appreciate slightly until the expiration date. Since the bull spread involves both buying and writing options for the underlying currency, bull spreads can be relatively cheap to construct and will not result in large losses if the currency depreciates. Conversely, bull spreads are useful tools to generate additional income for speculators.

Currency Bear Spreads

The easiest way to think about a currency bear spread is as a short bull spread. That is, a currency bear spread involves taking exactly the opposite positions involved in a bull spread. The bear spreader writes a call option for a particular underlying currency and simultaneously buys a call option for the same currency with a higher exercise price. Consequently, the bear spreader anticipates a modest depreciation in the foreign currency.

Currency Bear Spread Worksheet and Contingency Graph. For the Australian dollar example above, the bear spreader writes the $.64 option and buys the $.65 option. A worksheet and contingency graph can be constructed. One possible worksheet is shown on the next page:

	Value of Australian Dollar at Option Expiration				
	$.60	$.64	$.645	$.65	$.70
Sell a call	+$.019	+$.019	+$.014	+$.009	−$.041
Buy a call	−$.015	−$.015	−$.015	−$.015	+$.035
Net	+$.004	+$.004	−$.001	−$.006	−$.006

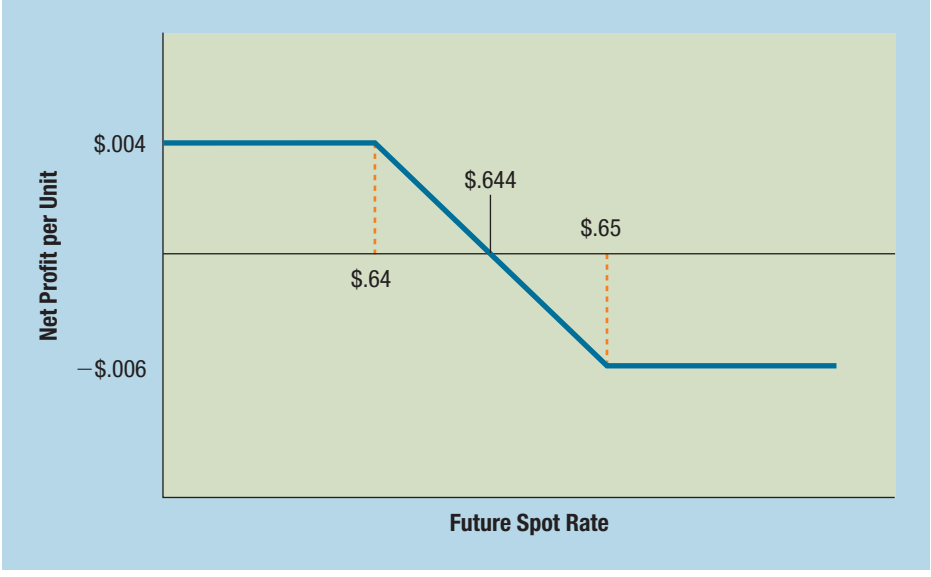
The corresponding contingency graph is shown in Exhibit 5B.6.

Notice that the worksheet and contingency graph for the bear spread are the mirror image of the worksheet and contingency graph for the bull spread. Consequently, the maximum gain for the bear spreader is limited to the difference between the two exercise prices of $.004 = $.019 − $.015, and the maximum loss for a bear spread (−$.006 = −$.65 + $.64 + $.004) occurs when the Australian dollar's value is equal to or above the exercise price at option expiration.

Also, the break-even point is located at the lower exercise price plus the difference in the two option premiums and is equal to $.644 = $.64 + $.004, which is the same break-even point as for the bull spread.

It is evident from the above illustration that the bear spreader hopes for a currency depreciation. An alternative way to profit from a depreciation would be to buy a put option for the currency. A bear spread, however, is typically cheaper to construct, since it involves buying one call option and writing another call option. The disadvantage of the bear spread compared to a long put position is that opportunity costs can be significant if the currency depreciates dramatically. Consequently, the bear spreader hopes for a modest currency depreciation.

Exhibit 5B.6 Contingency Graph for a Currency Bear Spread



PART 1 INTEGRATIVE PROBLEM

The International Financial Environment

Mesa Co. specializes in the production of small fancy picture frames, which are exported from the United States to the United Kingdom. Mesa invoices the exports in pounds and converts the pounds to dollars when they are received. The British demand for these frames is positively related to economic conditions in the United Kingdom. Assume that British inflation and interest rates are similar to the rates in the United States. Mesa believes that the U.S. balance-of-trade deficit from trade between the United States and the United Kingdom will adjust to changing prices between the two countries, while capital flows will adjust to interest rate differentials. Mesa believes that the value of the pound is very sensitive to changing international capital flows and is moderately sensitive to changing international trade flows. Mesa is considering the following information:

- The U.K. inflation rate is expected to decline, while the U.S. inflation rate is expected to rise.
- British interest rates are expected to decline, while U.S. interest rates are expected to increase.

Questions

1. Explain how the international trade flows should initially adjust in response to the changes in inflation (holding exchange rates constant). Explain how the international capital flows should adjust in response to the changes in interest rates (holding exchange rates constant).
2. Using the information provided, will Mesa expect the pound to appreciate or depreciate in the future? Explain.
3. Mesa believes international capital flows shift in response to changing interest rate differentials. Is there any reason why the changing interest rate differentials in this example will not necessarily cause international capital flows to change significantly? Explain.
4. Based on your answer to question 2, how would Mesa's cash flows be affected by the expected exchange rate movements? Explain.
5. Based on your answer to question 4, should Mesa consider hedging its exchange rate risk? If so, explain how it could hedge using forward contracts, futures contracts, and currency options.