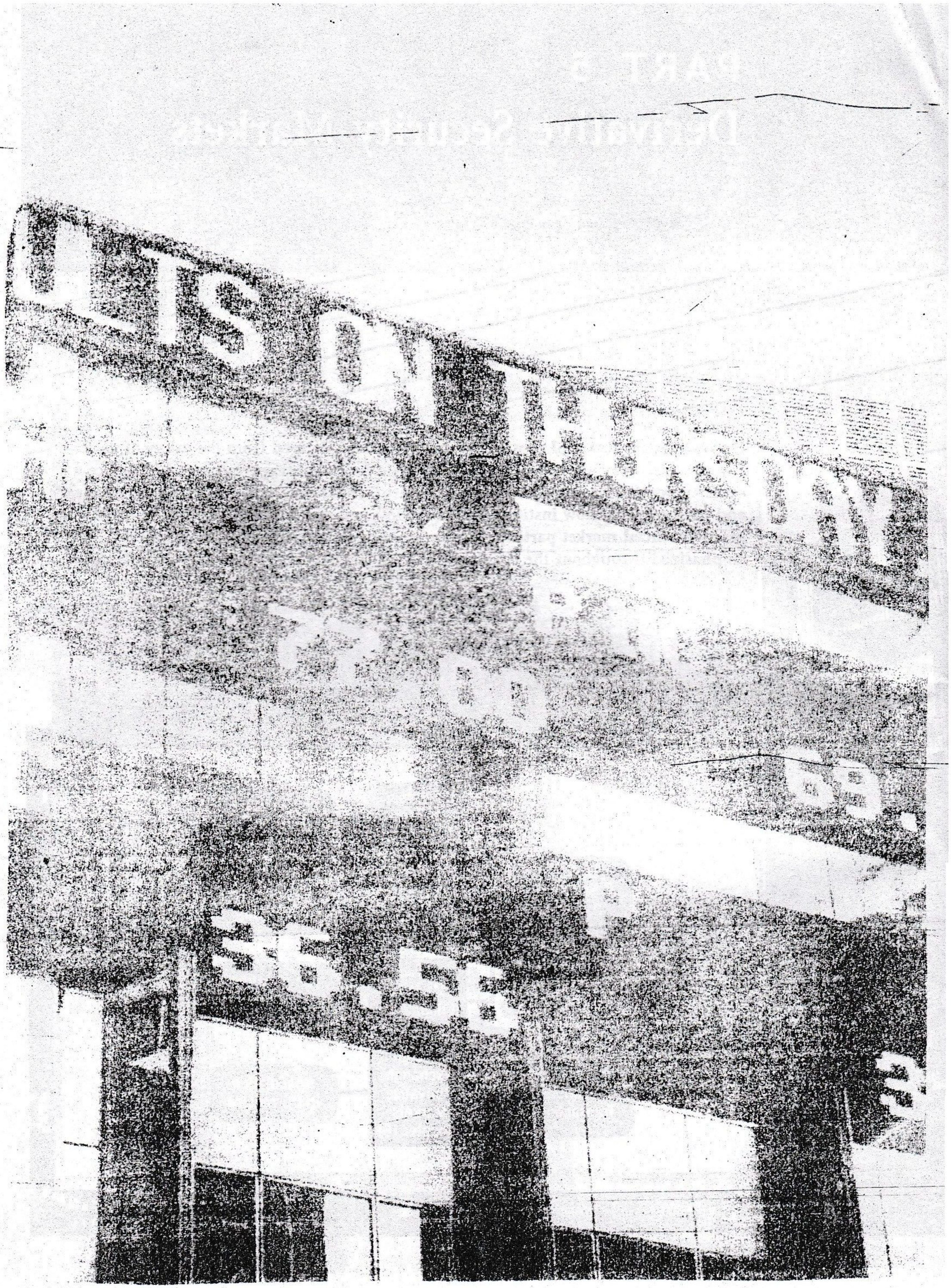
PART 5
Derivative Security Markets

Derivatives are financial contracts whose values are derived from the values of underlying assets. They are widely used to speculate on future expectations or to reduce a security portfolio's risk. The chapters in Part 5 focus on derivative security markets, and each explains how institutional portfolio managers and speculators use them. Many financial market participants simultaneously use all these markets, as is emphasized throughout the chapters.


USO
36.56

13 Financial Futures Markets

CHAPTER OBJECTIVES

The specific objectives of this chapter are to:

- provide a background on financial futures contracts,
- explain how interest rate futures contracts are used to speculate or hedge based on anticipated interest rate movements,
- explain how stock index futures contracts are used to speculate or hedge based on anticipated stock price movements,
- explain how single stock futures are used to speculate on anticipated stock price movements, and
- describe the different types of risk to which traders in financial futures contracts are exposed.

In recent years, financial futures markets have received much attention because they have the potential to generate large returns to speculators and because they entail a high degree of risk. However, these markets can also be used to reduce the risk of financial institutions and other corporations. Financial futures markets facilitate the trading of financial futures contracts.

13-1 Background on Financial Futures

A **financial futures contract** is a standardized agreement to deliver or receive a specified amount of a specified financial instrument at a specified price and date. The buyer of a financial futures contract buys the financial instrument, and the seller of a financial futures contract delivers the instrument for the specified price.

13-1a Popular Futures Contracts

Futures contracts are traded on a wide variety of securities and indexes.

Interest Rate Futures Many of the popular financial futures contracts are on debt securities such as Treasury bills, Treasury notes, Treasury bonds, and Eurodollar CDs. These contracts are referred to as **interest rate futures**. For each type of contract, the settlement dates at which delivery would occur are in March, June, September, and December.

Stock Index Futures There are also financial futures contracts on stock indexes, which are referred to as **stock index futures**. A stock index futures contract allows for the buying and selling of a stock index for a specified price at a specified date. Various stock index futures contracts are described in Exhibit 13.1.

13-1b Markets for Financial Futures

Markets have been established to facilitate the trading of futures contracts.

Futures Exchanges Futures exchanges provide an organized marketplace where standardized futures contracts can be traded. The exchanges clear, settle, and guarantee all transactions. They can ensure that each party's position is sufficiently backed by collateral as the market value of the position changes over time. In this way, any losses that occur are covered, so that counterparties are not adversely affected. Consequently, participants are more willing to trade financial futures contracts on an exchange.

Exhibit 13.1 Stock Index Futures Contracts

TYPE OF STOCK INDEX FUTURES CONTRACT	CONTRACT IS VALUED AS
S&P 500 index	$250 times index
Mini S&P 500 index	$50 times index
S&P Midcap 400 index	$500 times index
S&P Small Cap index	$200 times index
Nasdaq 100 index	$100 times index
Mini Nasdaq 100 index	$20 times index
Mini Nasdaq Composite index	$20 times index
Russell 2000 index	$500 times index

Most financial futures contracts in the United States are traded through the CME Group, which was formed in July 2007 by the merger of the Chicago Board of Trade (CBOT) and the Chicago Mercantile Exchange (CME). The CBOT specialized in futures contracts on Treasury bonds and agricultural products, and also traded stock options (described in the next chapter). The CME specialized in futures contracts on money market securities, stock indexes, and currencies.

The CME went public in 2002, and the CBOT went public in 2005. Their merger to form the CME Group created the world's largest and most diverse derivatives exchange, which serves international markets for derivative products. As part of the restructuring to increase efficiency, the CME and CBOT trading floors were consolidated into a single trading floor (at the CBOT) and their products were consolidated on a single electronic platform, which has reduced operating and maintenance expenses.

The operations of financial futures exchanges are regulated by the Commodity Futures Trading Commission (CFTC). The CFTC approves futures contracts before they can be listed by futures exchanges and imposes regulations to prevent unfair trading practices.

Over-the-Counter Market Some specialized futures contracts are sold "over the counter" rather than on an exchange, whereby a financial intermediary (such as a commercial bank or an investment bank) finds a counterparty or serves as the counterparty. These over-the-counter arrangements are more personalized and can be tailored to the specific preferences of the parties involved. Such tailoring is not possible for the more standardized futures contracts sold on the exchanges.

WEB

www.cftc.gov
Detailed information on the CFTC.

WEB

www.nfa.futures.org
Information for investors who wish to trade futures contracts.

13-1c Purpose of Trading Financial Futures

Financial futures are traded either to speculate on prices of securities or to hedge existing exposure to security price movements. **Speculators** in financial futures markets take positions to profit from expected changes in the price of futures contracts over time. They can be classified according to their methods. **Day traders** attempt to capitalize on price movements during a single day; normally, they close out their futures positions on the same day the positions were initiated. **Position traders** maintain their futures positions for longer periods of time (for weeks or months) and thus attempt to capitalize on expected price movements over a more extended time horizon.

Hedgers take positions in financial futures to reduce their exposure to future movements in interest rates or stock prices. Many hedgers who maintain large portfolios of stocks or bonds take a futures position to hedge their risk. Speculators commonly take the opposite position and therefore serve as the counterparty on many futures transactions. Thus, speculators provide liquidity to the futures market.

13-1d Institutional Trading of Futures Contracts

www.cmegroup.com
Offers details about the products offered by the CME Group and also provides price quotations of the various futures contracts.

Exhibit 13.2 summarizes how various types of financial institutions participate in futures markets. Financial institutions generally use futures contracts to reduce risk. Some commercial banks, savings institutions, bond mutual funds, pension funds, and insurance companies trade interest rate futures contracts to protect against a possible increase in interest rates, thereby insulating their long-term debt securities from interest rate risk. Some stock mutual funds, pension funds, and insurance companies trade stock index futures to partially insulate their respective stock portfolios from adverse movements in the stock market.

13-1e Trading Process

www.bloomberg.com
Today's prices of U.S. bond futures contracts and prices of currency futures contracts.

When the futures exchanges were created, they relied on **commission brokers** (also called floor brokers) to execute orders for their customers, which generally were brokerage firms. In addition, **floor traders** (also called **locals**) traded futures contracts for their own account. The commission brokers and floor traders went to a specific location on the trading floor where the futures contract was traded to execute the order. Market-makers can also execute futures contract transactions for customers. They may facilitate a buy order for one customer and a sell order for a different customer. The market-maker earns the difference between the bid price and the ask price for such a trade, although the spread has declined significantly in recent years. Market-makers also earn profits when they use their own funds to take positions in futures contracts. Like any investors, they are subject to the risk of losses on their positions.

Electronic Trading Most futures contracts are now traded electronically. The CME Group has an electronic trading platform called Globex that complements its floor

Exhibit 13.2 Institutional Use of Futures Markets

TYPE OF FINANCIAL INSTITUTION	PARTICIPATION IN FUTURES MARKETS
Commercial banks	• Take positions in futures contracts to hedge against interest rate risk.
Savings institutions	• Take positions in futures contracts to hedge against interest rate risk.
Securities firms	• Execute futures transactions for individuals and firms. • Take positions in futures contracts to hedge their own portfolios against stock market or interest rate movements.
Mutual funds	• Take positions in futures contracts to speculate on future stock market or interest rate movements. • Take positions in futures contracts to hedge their portfolios against stock market or interest rate movements.
Pension funds	• Take positions in futures contracts to hedge their portfolios against stock market or interest rate movements.
Insurance companies	• Take positions in futures contracts to hedge their portfolios against stock market or interest rate movements.

trading. Some futures contracts are traded both on the trading floor and on Globex, whereas others are traded only on Globex. Transactions can occur on Globex virtually around the clock (the platform is closed about one hour per day for maintenance) and on weekends. In 2004, the Chicago Board Options Exchange (CBOE) opened a fully electronic futures exchange.

13-1f Trading Requirements

Customers who desire to buy or sell futures contracts open accounts at brokerage firms that execute futures transactions. Under exchange requirements, a customer must establish a margin deposit with the broker before a transaction can be executed. This initial margin is typically between 5 and 18 percent of a futures contract's full value. Brokers commonly require margin deposits above those required by the exchanges. As the futures contract price changes on a daily basis, its value is "marked to market," or revised to reflect the prevailing conditions. A customer whose contract values moves in an unfavorable direction may receive a margin call from the broker, requiring that additional funds be deposited in the margin account. The margin requirements reduce the risk that customers will later default on their obligations.

www.cmegroup.com/globex
Information about how investors can engage in electronic trading of futures contracts.

Type of Orders Customers can place a market order or a limit order. With a market order, the trade will automatically be executed at the prevailing price of the futures contract; with a limit order, the trade will be executed only if the price is within the limit specified by the customer. For example, a customer may place a limit order to buy a particular futures contract if it is priced no higher than a specified price. Similarly, a customer may place an order to sell a futures contract if it is priced no lower than a specified minimum price.

How Orders Are Executed Although most trading now takes place electronically, some trades are still conducted on the trading floor. In that case, the brokerage firm

USING THE WALL STREET JOURNAL

Interest Rate Futures

The *Wall Street Journal* provides information on interest rate futures, as shown here. Specifically, it discloses the recent open price, range (high and low), and final closing (settle) price over the previous trading day. It also discloses the number of existing contracts (open interest). Financial institutions closely monitor interest rate futures prices when considering whether to hedge their interest rate risk.

Interest Rate Futures

Treasury Bonds (CBT) $100,000; pts 32nds of 100%						
March	145-170	146-110	145-000	**145-050**	-15.0	298,397
Treasury Notes (CBT) $100,000; pts 32nds of 100%						
March	132-200	132-315	132-170	**132-185**	-3.0	725,004
June	131-155	131-270	131-120	**131-140**	-3.0	1,450,878
5 Yr. Treasury Notes (CBT) $100,000; pts 32nds of 100%						
March	124-102	124-145	124-095	**124-102**	-.2	580,267
June	123-292	124-017	123-287	**123-295**	...	1,276,366
2 Yr. Treasury Notes (CBT) $200,000; pts 32nds of 100%						
March	110-065	110-090	110-077	**110-080**	-.5	438,873
June	110-072	110-077	110-070	**110-072**	...	708,150
30 Day Federal Funds (CBT) $5,000,000; 100 - daily avg						
Feb	99.855	99.855	99.853	**99.855**	...	43,817
March	99.555	99.860	99.850	**99.855**	...	40,419
10 Yr. Int. Rate Swaps (CBT) $100,000; pts 32nds of 100%						
March	118.422	118.516	118.000	**117.984**	-.203	12,308
1 Month Libor (CME) $3,000,000; pts of 100%						
March				**99.7950**	-.0025	446
Eurodollar (CME) $1,000,000; pts of 100%						
March	99.7050	99.7075	99.7025	**99.7050**	-.0025	895,003
June	99.6800	99.6850	99.6750	**99.6800**	...	789,912
Sept	99.6550	99.6600	99.6500	**99.6600**	...	737,645
Dec	99.6350	99.6350	99.6250	**99.6350**	...	808,956

Source: Reprinted with permission of the *Wall Street Journal*, Copyright © 2013 Dow Jones & Company, Inc. All Rights Reserved Worldwide.

communicates its customers' orders to telephone stations located near the trading floor of the futures exchange. The floor brokers accommodate these orders. Each type of financial futures contract is traded in a particular location on the trading floor. The floor brokers make their offers to trade by open outcry, specifying the quantity of contracts they wish to buy or sell. Other floor brokers and traders interested in trading the particular type of futures contract can respond to the open outcry. When two traders on the trading floor reach an agreement, each trader documents the specifics of the agreement (including the price), and the information is transmitted to the customers.

Floor brokers receive transaction fees in the form of a bid–ask spread. That is, they purchase a given futures contract for one party at a slightly lower price than the price at which they sell the contract to another party. For every buyer of a futures contract, there must be a corresponding seller.

The futures exchange facilitates the trading process but does not itself take buy or sell positions on the futures contract. Instead, the exchange acts as a clearinghouse. A clearinghouse facilitates the trading process by recording all transactions and guaranteeing timely payments. This precludes the need for a purchaser of a futures contract to check the creditworthiness of the contract seller. In fact, purchasers of contracts do not even know who the sellers are, and vice versa. The clearinghouse also supervises the delivery specified by contracts as of the settlement date.

www.cmegroup.com
Quotations for futures contracts.

Futures contracts representing debt securities such as bonds result in the delivery of those securities at the settlement date. Futures contracts that represent an index (such as a bond index or stock index) are settled in cash.

13-2 Interest Rate Futures Contracts

Interest rate futures contracts specify a face value of the underlying securities (such as $1,000,000 for T-bill futures and $100,000 for Treasury bond futures), a maturity of the underlying securities, and the settlement date when delivery would occur. There is a minimum price fluctuation for each contract, such as $^1/_{32}$ of a point ($1,000), or $31.25 per contract.

There are also futures contracts on bond indexes, which allow for the buying and selling of a particular bond index for a specified price at a specified date. For financial institutions that trade in municipal bonds, there are **Municipal Bond Index (MBI) futures**. The index is based on the **Bond Buyer Index** of 40 actively traded general obligation and revenue bonds. The specific characteristics of MBI futures are shown in Exhibit 13.3.

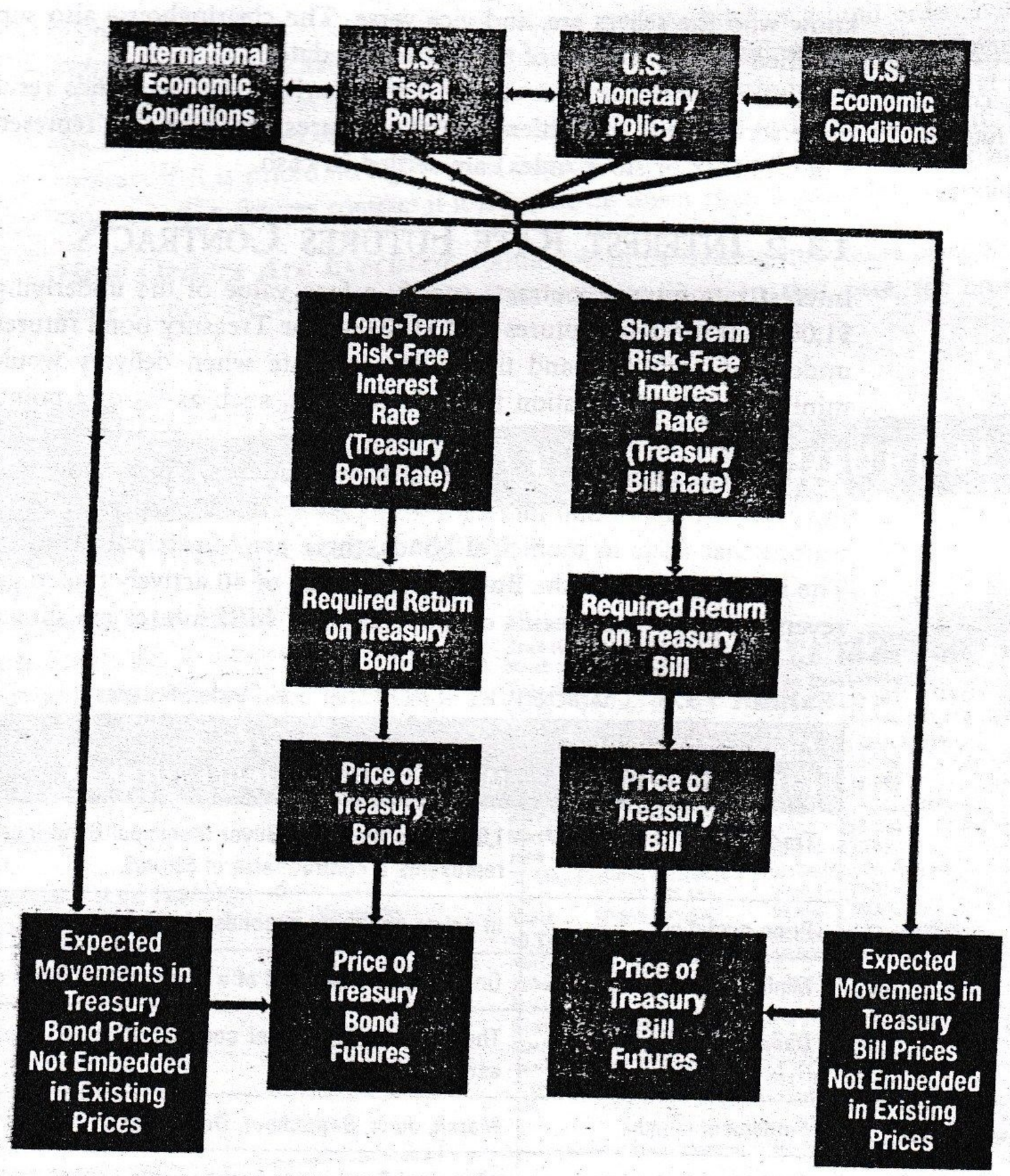
Exhibit 13.3 Characteristics of Municipal Bond Index Futures

CHARACTERISTICS OF FUTURES CONTRACT	MUNICIPAL BOND INDEX FUTURES
Trading unit	1,000 times the Bond Buyer Municipal Bond Index. A price of 90–00 represents a contract size of $90,000.
Price quotation	In points and thirty-seconds of a point.
Minimum price fluctuation	One thirty-second ($^1/_{32}$) of a point, or $31.25 per contract.
Daily trading limits	Three points ($3,000) per contract above or below the previous day's settlement price.
Settlement months	March, June, September, December.
Settlement procedure	Municipal Bond Index futures settle in cash on the last day of trading.

13-2a Valuing Interest Rate Futures

The price of an interest rate futures contract generally reflects the expected price of the underlying security on the settlement date. Thus any factors that influence that expected price should influence the current prices of the interest futures contracts. Participants in the Treasury bond futures market closely monitor the economic indicators that affect Treasury bond prices, as shown in Exhibit 13.4. Some of the more closely monitored indicators of economic growth include employment, gross domestic product, retail sales, industrial production, and consumer confidence. When indicators signal an increase in economic growth, participants anticipate an increase in interest rates, which places downward pressure on bond prices and therefore also on Treasury bond futures prices. Conversely, when indicators signal a decrease in economic growth, participants

Exhibit 13.4 Framework for Explaining Changes over Time in the Futures Prices of Treasury Bonds and Treasury Bills



anticipate lower interest rates, which places upward pressure on bond prices and therefore also on Treasury bond futures.

Participants in the Treasury bond futures market also closely monitor indicators of inflation, such as the consumer price index and the producer price index. In general, an unexpected increase in these indexes tends to create expectations of higher interest rates and places downward pressure on bond prices and hence also on Treasury bond futures prices.

Indicators that reflect the amount of long-term financing are also monitored. For example, announcements about the government deficit or the amount of money that the Treasury hopes to borrow in a Treasury bond auction are closely monitored. Any information that implies more government borrowing than expected tends to signal upward pressure on the long-term risk-free interest rate (the Treasury bond rate), downward pressure on bond prices, and therefore downward pressure on Treasury bond futures prices.

13-2b Speculating in Interest Rate Futures

Speculators who anticipate future movements in interest rates can likewise anticipate the future direction of Treasury security values and therefore how valuations of interest rate futures will change. Speculators take positions in interest rate futures that will benefit them if their expectations prove to be correct.

EXAMPLE

In February, Jim Sanders forecasts that interest rates will decrease over the next month. If his expectation is correct, the market value of T-bills should increase. Sanders calls a broker and purchases a T-bill futures contract. Assume that the price of the contract was 94.00 (a 6 percent discount) and that the price of T-bills on the March settlement date is 94.90 (a 5.1 percent discount). Sanders can accept delivery of these T-bills and sell them for more than he paid for them. Because the T-bill futures represent $1 million of par value, the nominal profit from this speculative strategy is

Selling price	$949,000	(94.90% of $1,000,000)
− Purchase price	−940,000	(94.00% of $1,000,000)
= Profit	$9,000	(0.90% of $1,000,000)

In this example, Sanders benefited from his speculative strategy because interest rates declined from the time he took the futures position until the settlement date. If interest rates had risen over this period, the price of T-bills on the settlement date would have been below 94.00 (reflecting a discount above 6 percent), and Sanders would have incurred a loss.

EXAMPLE

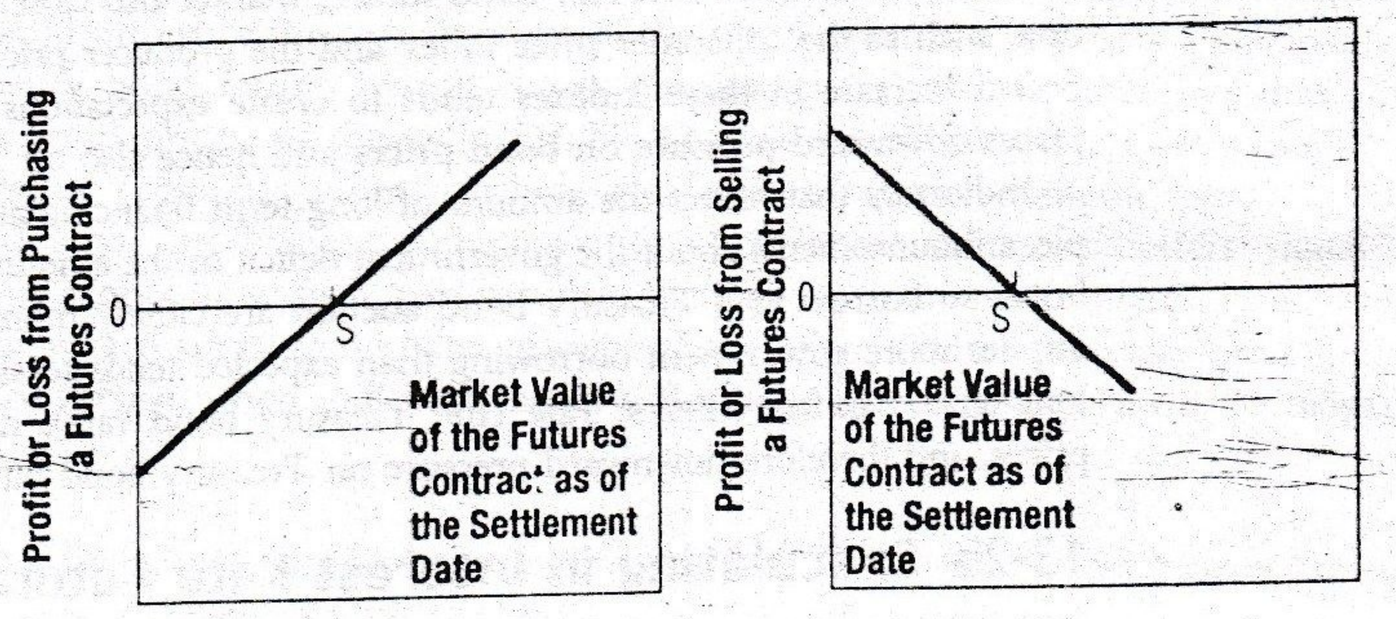
Assume that the price of T-bills as of the March settlement date is 92.50 (representing a discount of 7.5 percent). In this case, the nominal profit from Sanders's speculative strategy is

Selling price	$925,000	(92.50% of $1,000,000)
− Purchase price	−940,000	(94.00% of $1,000,000)
= Profit	−$15,000	(−1.50% of $1,000,000)

Now suppose instead that, in February, Sanders had anticipated that interest rates would rise by March. He therefore sold a T-bill futures contract with a March settlement date, obligating him to provide T-bills to the purchaser on that delivery date. When T-bill prices declined in March, Sanders was able to obtain T-bills at a market price lower than the price at which he was obligated to sell those bills. Again, there is always the risk that interest rates (and therefore T-bill prices) will move contrary to expectations. In that case, Sanders would have paid a higher market price for the T-bills than the price at which he could sell them. ●

Payoffs from Speculating in Interest Rate Futures The potential payoffs from speculating in futures contracts are illustrated in Exhibit 13.5. The left graph

Exhibit 13.5 Potential Payoffs from Speculating in Financial Futures



represents a purchaser of futures, and the right graph represents a seller of futures. The S on each graph indicates the initial price at which a futures position is created. The horizontal axis represents the market value of the securities in terms of a futures contract as of the delivery date. The maximum possible loss when purchasing futures is the amount to be paid for the securities, but this loss will occur only if the market value of the securities falls to zero. The amount of gain (or loss) to a speculator who initially purchased futures will equal the loss (or gain) to a speculator who initially sold futures on the same date, assuming zero transaction costs.

Impact of Leverage Because investors commonly use a margin account to take futures positions, the return from speculating in interest rate futures should reflect the degree of financial leverage involved. This return is magnified substantially when considering the relatively small margin maintained by many investors.

EXAMPLE

In the example where Jim Sanders earned a profit of $9,000 on a futures contract, this profit represents 0.90 percent of the value of the underlying contract par value. Consider that Sanders could have taken the interest rate futures position with an initial margin of perhaps $10,000. Under these conditions, the $9,000 profit represents a return of 90 percent over the period of less than two months in which he maintained the futures position.

Just as financial leverage magnifies positive returns, it also magnifies losses. In the example where Sanders lost $15,000 on a futures contract, he would have lost 100 percent of his initial margin, and thus would have been required to add more funds to his margin account, when the value of the futures position began to decline. ●

Closing Out the Futures Position Most buyers or sellers of financial futures contracts do not actually make or accept delivery of the financial instrument; instead, they offset their positions by the settlement date. In the previous example, if Jim Sanders did not want to accept delivery of the T-bills at settlement date, he could have sold a T-bill futures contract with a March settlement date at any time before that date. Since his second transaction requires that he deliver T-bills at the March settlement date but his initial transaction allows him to receive T-bills at the March settlement date, his obligations net out.

When closing out a futures position, a speculator's gain (or loss) is based on the difference between the price at which a futures contract is sold and the price at which that same type of contract is purchased.

EXAMPLE Suppose Kim Bennett purchased a futures contract on Treasury bonds at a price of 90-00 on October 2. One month later, she sells the same futures contract in order to close out the position. At this time, the futures contract specifies the price as 92-10, or $92^{10}/_{32}$ percent of the par value. Given that the futures contract on Treasury bonds specifies a par value of $100,000, the nominal profit is

Selling price	**$92,312**	**($92^{10}/_{32}$% of $100,000)**
− Purchase price	**−90,000**	**(90.00% of $100,000)**
= Profit	**$2,312**	**($2^{10}/_{32}$% of $100,000)**

When the initial position is a sale of the futures contract, a purchase of that same type of contract will close out the position. For example, assume that Chris Harper sold Treasury bond futures on October 2 at a price of 90–00 and then took an offsetting position one month later to close out his position. Using the same numbers as before, a loss of $2,312 (ignoring transaction costs) will result from closing out his position one month later. Speculators are willing to close out a position at a loss when they expect that a larger loss will occur if the position is not closed out. ●

13-2c Hedging with Interest Rate Futures

Financial institutions can classify their assets and liabilities in terms of the sensitivity of their market value to interest rate movements. The difference between a financial institution's volume of rate-sensitive assets and rate sensitive liabilities represents its exposure to interest rate risk. Over the long run, an institution may attempt to restructure its assets or liabilities in order to balance its degree of rate sensitivity. However, restructuring the balance sheet takes time. In the short run, the institution may consider using financial futures to hedge its exposure to interest rate movements. A variety of financial institutions use financial futures to hedge their interest rate risk, including mortgage companies, securities dealers, commercial banks, savings institutions, pension funds, and insurance companies.

Using Interest Rate Futures to Create a Short Hedge Financial institutions commonly take a position in interest rate futures to create a short hedge, which represents the sale of a futures contract on debt securities or an index that is similar to its assets. The "short" position from the futures contract is taken to hedge the institution's "long" position (in its own assets).

Consider a commercial bank that currently holds a large amount of corporate bonds. Its primary source of funds is short-term deposits. The bank will be adversely affected if interest rates rise in the near future because its liabilities are more rate-sensitive than its assets. Although the bank believes that its bonds are a reasonable long-term investment, it anticipates that interest rates will rise temporarily. Therefore, it hedges against the interest rate risk by selling futures on securities that have characteristics similar to the securities it is holding, so that the futures prices will change in tandem with these securities. One strategy is to sell Treasury bond futures, since the price movements of Treasury bonds are highly correlated with movements in corporate bond prices.

If interest rates rise as expected, the market value of existing corporate bonds held by the bank will decline. Yet this decline could be offset by the favorable impact of the futures position. The bank locked in the price at which it could sell Treasury bonds. It can purchase Treasury bonds at a lower price just prior to settlement of the futures contract (because the value of bonds will have decreased) and profit after fulfilling its futures contract obligation. Alternatively, it could offset its short position by purchasing futures contracts similar to the type that it sold earlier.

EXAMPLE Assume that Charlotte Insurance Company plans to satisfy cash needs in six months by selling its Treasury bond holdings for $5 million at that time. It is concerned that interest rates might increase over the next three months, which would reduce the market value of the bonds by the time they

are sold. To hedge against this possibility, Charlotte plans to sell Treasury bond futures. It sells 50 Treasury bond futures contracts with a par value of $5 million ($100,000 per contract) for 98-16 (i.e., 98$^{16}/_{32}$ percent of par value).

Suppose that the actual price of the futures contract declines to 94-16 because of an increase in interest rates. Charlotte can close out its short futures position by purchasing contracts identical to those it has sold. If it purchases 50 Treasury bond futures contracts at the prevailing price of 94-16, its profit per futures contract will be

Selling price	$98,500	(98.50% of $100,000)
− Purchase price	−94,500	(94.50% of $100,000)
= Profit	$4,000	(4.00% of $100,000)

Charlotte had a position in 50 futures contracts, so its total profit from that position will be $200,000 ($4,000 per contract × 50 contracts). This gain on the futures contract position will help offset the reduced market value of Charlotte's bond holdings. Charlotte could also have earned a gain on its position by purchasing an identical futures contract just before the settlement date.

If interest rates rise by a greater degree over the six-month period, the market value of Charlotte's Treasury bond holdings will decrease further. However, the price of Treasury bond futures contracts will also decrease by a greater degree, creating a larger gain from the short position in Treasury bond futures. If interest rates decrease, the futures prices will rise, causing a loss on Charlotte's futures position. But that will be offset by a gain in the market value of Charlotte's bond holdings. In this case, the firm would have experienced better overall performance without the hedge. Firms cannot know whether a hedge of interest rate risk will be beneficial in a future period because they cannot always predict the direction of future interest rates. ●

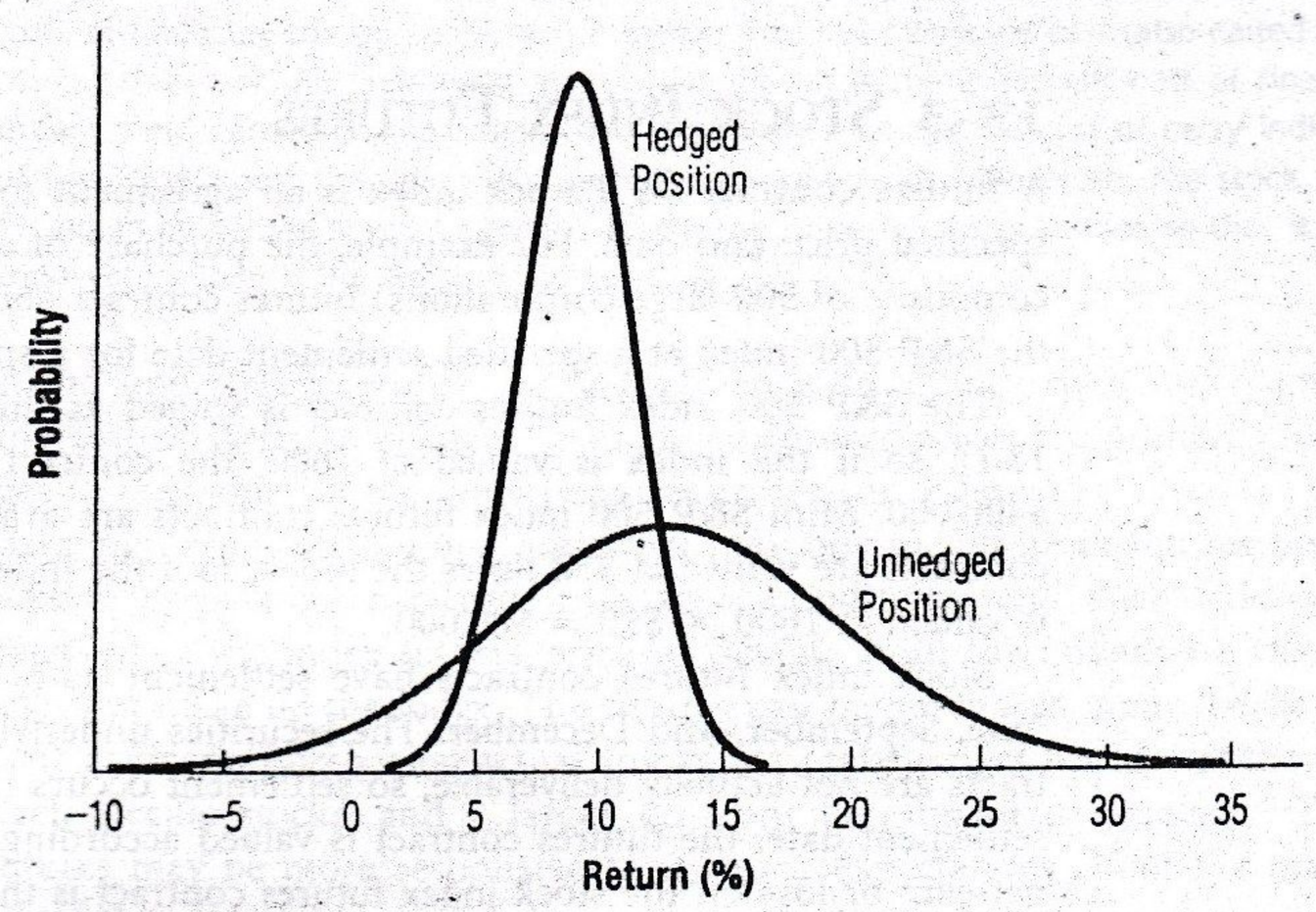
Cross-Hedging The preceding example presumes that the basis, or the difference between the price of a security and the price of a futures contract, remains the same. In reality, the price of the security may fluctuate more or less than the futures contract used to hedge it. If so, a perfect offset will not result when a given face value amount of securities is hedged with the same face value amount of futures contracts.

The use of a futures contract on one financial instrument to hedge a position in a different financial instrument is known as cross-hedging. The effectiveness of a cross-hedge depends on the degree of correlation between the market values of the two financial instruments. If the price of the underlying security of the futures contract moves nearly in tandem with the security being hedged, the futures contract can provide an effective hedge.

Even when the futures contract is highly correlated with the portfolio being hedged, the value of the futures contract may change by a higher or lower percentage than the portfolio's market value. If the futures contract value is less volatile than the portfolio value, hedging will require a greater amount of principal represented by the futures contracts. For example, assume that the value of the portfolio moves by 1.25 percent for every percentage point movement in the price of the futures contract. In this case, the value of futures contracts needed to fully hedge the portfolio would be 1.25 times the principal of the portfolio.

Trade-off from Using a Short Hedge When considering the rising and the declining interest rate scenarios, the advantages and disadvantages of interest rate futures are obvious. Interest rate futures can hedge against both adverse and favorable events. Exhibit 13.6 compares two probability distributions of returns generated by a financial institution whose liabilities are more rate-sensitive than its assets. If the institution hedges its exposure to interest rate risk, its probability distribution of returns is narrower than if it does not hedge. The return when hedging would have been higher than the return without hedging if interest rates increased (left side of the graph) but lower if interest rates decreased (right side).

Exhibit 13.6 Comparison of Probability Distributions of Returns; Hedged versus Unhedged Positions



A financial institution that hedges with interest rate futures is less sensitive to economic events. Thus, financial institutions that frequently use interest rate futures may be able to reduce the variability of their earnings over time, which reflects a lower degree of risk. However, it is virtually impossible to perfectly hedge the sensitivity of all cash flows to interest rate movements.

www.cmegroup.com
Go to the section on Market Data where quotes are provided in order to review quotes on interest rate futures.

Using Interest Rate Futures to Create a Long Hedge Some financial institutions use a **long hedge** to reduce exposure to the possibility of declining interest rates. Consider government securities dealers who plan to purchase long-term bonds in a few months. If the dealers are concerned that prices of these securities will rise before the time of their purchases, they may purchase Treasury bond futures contracts. These contracts lock in the price at which Treasury bonds can be purchased, regardless of what happens to market rates prior to actual purchase of the bonds.

As another example, consider a bank that has obtained a significant portion of its funds from large CDs with a maturity of five years. Also assume that most of its assets represent loans with rates that adjust every six months. This bank would be adversely affected by a decline in interest rates because interest earned on assets would be more sensitive than interest paid on liabilities. To hedge against the possibility of lower interest rates, the bank could purchase T-bill futures to lock in the price on T-bills at a specified future date. If interest rates decline, the gain on the futures position could partially offset any reduction in the bank's earnings due to the reduction in interest rates.

Hedging Net Exposure Because interest rate futures contracts entail transaction costs, they should be used only to hedge **net exposure,** which is the difference between asset and liability positions. Consider a bank that has $300 million in long-term assets and $220 million worth of long-term, fixed-rate liabilities. If interest rates rise, the market value of the long-term assets will decline but the bank will benefit from the fixed rate on the $220 million in long-term liabilities. Thus, the bank's net exposure is

only $80 million (assuming that the long-term assets and liabilities are similarly affected by rising interest rates). This financial institution should therefore focus on hedging its net exposure of $80 million by creating a short hedge.

13-3 Stock Index Futures

A futures contract on a stock index is an agreement to purchase or sell an index at a specified price and date. For example, the purchase of an S&P 500 (which represents a composite of 500 large corporations) futures contract obligates the purchaser to purchase the S&P 500 index at a specified settlement date for a specified amount.

The S&P 500 index futures contract is valued as the index times $250 (see Exhibit 13.1), so if the index is valued at 1600, the contract is valued at 1600 × $250 = $400,000. Mini S&P 500 index futures contracts are available for small investors. These contracts are valued at $50 times the index, so if the index is valued at 1600, the contract is valued at 1600 × $50 = $80,000.

Stock index futures contracts have settlement dates on the third Friday in March, June, September, and December. The securities underlying the stock index futures contracts are not actually deliverable, so settlement occurs through a cash payment. On the settlement date, the futures contract is valued according to the quoted stock index. The net gain or loss on the stock index futures contract is the difference between the futures price when the initial position was created and the value of the contract as of the settlement date.

Like other financial futures contracts, stock index futures can be closed out before the settlement date by taking an offsetting position. For example, if an S&P 500 futures contract with a December settlement date is purchased in September, this position can be closed out in November by selling an S&P 500 futures contract with the same December settlement date. When a position is closed out prior to the settlement date, the net gain or loss on the stock index futures contract is the difference between the futures price when the position was created and the futures price when the position is closed out.

Recently, sector index futures have also been created so that investors can buy or sell an index that reflects a particular sector. These contracts are distinguished from stock index futures because they represent a component of a stock index. Investors who are optimistic about the stock market in general might be more interested in stock index futures, while investors who are especially optimistic about one particular sector may be more interested in sector index futures. Sector index futures contracts are available for many different sectors, including consumer goods, energy, financial services, health care, industrial, materials, technology, and utilities.

13-3a Valuing Stock Index Futures

The value of a stock index futures contract is highly correlated with the value of the underlying stock index. However, the value of the stock index futures contract commonly differs from the price of the underlying asset because of some unique features of the stock index futures contract.

EXAMPLE

Consider that an investor can buy either a stock index or a futures contract on the stock index with a settlement date of six months from now. On the one hand, the buyer of the index receives dividends whereas the buyer of the index futures does not. On the other hand, the buyer of the index must use funds to buy the index whereas the buyer of index futures can engage in the futures contract simply by establishing a margin deposit with a relatively small amount of assets (such as Treasury securities), which may generate interest while being used to satisfy margin requirements.

Assume that the index will pay dividends equal to 3 percent over the next six months. Also assume that the purchaser of the index will borrow funds to purchase the index at an interest rate of 2 percent over the six-month period. In this example, the advantage of holding the index (a 3 percent dividend yield) relative to holding a futures contract on the index more than offsets the 2 percent cost of financing the purchase of the index. The *net financing cost* (also called "cost of carry") to the purchaser of the underlying assets (the index) is the 2 percent cost of financing minus the 3 percent yield earned on the assets, or −1 percent. A negative cost of carry indicates that the cost of financing is less than the yield earned from dividends. Therefore, the stock index futures contract should be valued about 1 percent above the underlying stock index so that it is no less desirable to investors than is the stock index itself. ●

In general, the underlying security (or index) tends to change by a much greater degree than the cost of carry, so changes in financial futures prices are primarily attributed to changes in the values of the underlying securities (or indexes).

In some cases, numerous institutional investors may buy or sell index futures instead of selling stocks to prepare for a change in market conditions, and their actions can cause the movement in the index futures price to deviate from the underlying value of the actual stocks that make up the index. The futures can be purchased immediately with a small, up-front payment. Purchasing actual stocks may take longer because of the time needed to select specific stocks, and a larger up-front investment is necessary. Thus, stock index futures may be more responsive to investor expectations about the market than are values of the underlying stock prices.

Indicators of Stock Index Futures Prices Because stock index futures prices are primarily driven by movements in the corresponding stock indexes, participants in stock index futures monitor indicators that may signal movements in the stock indexes. The economic indicators that signal changes in bond futures prices can also affect stock futures prices, but not necessarily in the same manner. Whereas economic conditions that cause expectations of higher interest rates adversely affect prices of Treasury bonds (and therefore Treasury bond futures), the impact of such expectations on a stock index (and therefore on stock index futures) is not as clear.

13-3b Speculating in Stock Index Futures

Stock index futures can be traded to capitalize on expectations about general stock market movements. Speculators who expect the stock market to perform well before the settlement date may consider purchasing S&P 500 index futures. Conversely, participants who expect the stock market to perform poorly before the settlement date may consider selling S&P 500 index futures.

EXAMPLE

Boulder Insurance Company plans to purchase a variety of stocks for its stock portfolio in December, once cash inflows are received. Although the company does not have cash to purchase the stocks immediately, it is anticipating a large jump in stock market prices before December. Given this situation, it decides to purchase S&P 500 index futures. The futures price on the S&P 500 index with a December settlement date is 1500. The value of an S&P 500 futures contract is $250 times the index. Because the S&P 500 futures price should move with the stock market, it will rise over time if the company's expectations are correct. Assume that the S&P 500 index rises to 1600 on the settlement date.

In this example, the nominal profit on the S&P 500 index futures is

Selling price	$400,000	(Index value of 1600 × $250)
− Purchase price	−375,500	(Index value of 1500 × $250)
= Profit	$25,000	

USING THE WALL STREET JOURNAL

Index Futures

The *Wall Street Journal* provides information on stock index futures, as shown here. Specifically, it discloses the recent open price, range (high and low), and final closing (settle) price over the previous trading day. In addition, it discloses the number of existing contracts (open interest). Financial institutions closely monitor interest rate futures prices when considering whether to hedge their market risk.

Source: Reprinted with permission of the *Wall Street Journal*, Copyright © 2013 Dow Jones & Company, Inc. All Rights Reserved Worldwide.

Index Futures

DJ Industrial Average (CBT)-$10 x index						
March	13876	14086 ▲	13848	14060	201	15,656
Mini DJ Industrial Average (CBT)-$5 x index						
March	13870	14091 ▲	13846	14060	201	119,082
June	13807	14018 ▲	13780	13991	200	5,173
S&P 500 Index (CME)-$250 x index						
March	1493.30	1519.00	1490.20	1515.80	23.40	217,537
June	1492.50	1510.50	1500.70	1509.80	23.30	7,911
Mini S&P 500 (CME)-$50 x index						
March	1493.25	1519.25	1490.00	1515.75	23.25	3,129,679
June	1487.50	1513.00	1484.25	1509.75	23.25	101,889
Mini S&P Midcap 400 (CME)-$100 x index						
March	1084.60	1106.20	1082.60	1102.80	18.50	122,060
June	1084.00	1103.20	1081.10	1100.00	18.40	766
Nasdaq 100 (CME)-$100 x index						
March	2710.50	2759.00	2704.75	2740.50	32.75	15,205
June	2710.00	2749.00	2733.00	2734.25	33.00	130
Mini Nasdaq 100 (CME)-$20 x index						
March	2711.0	2757.8	2703.3	2740.5	32.8	325,434
June	2705.0	2751.8	2697.5	2734.3	33.0	6,277
Mini Russell 2000 (ICE-US)-$100 x index						
March	895.90	913.60	894.90	909.10	12.50	369,541
June	893.90	909.90	893.20	905.30	12.40	567
Mini Russell 1000 (ICE-US)-$100 x index						
March	829.60	843.90	829.60	842.40	12.60	11,613
U.S. Dollar Index (ICE-US)-$1,000 x index						
March	81.94	81.99 ▲	81.56	81.67	-.27	67,947
June	82.15	82.20 ▲	81.75	81.87	-.28	1,633

Source: SIX Financial Information

Thus Boulder was able to capitalize on its expectations even though it did not have sufficient cash to purchase stock. If stock prices had declined over the period of concern, the S&P 500 futures price would have decreased and Boulder would have incurred a loss on its futures position. ●

13-3c Hedging with Stock Index Futures

Stock index futures are also commonly used to hedge the market risk of an existing stock portfolio.

EXAMPLE Glacier Stock Mutual Fund expects the stock market to decline temporarily, causing a temporary decline in its stock portfolio. The fund could sell its stocks with the intent to repurchase them in the near future, but this would incur excessive transaction costs. A more efficient solution is to sell stock index futures. If the fund's stock portfolio is similar to the S&P 500 index, Glacier can sell futures contracts on that index. If the stock market declines as expected, Glacier will generate a gain when closing out the stock index futures position, which will somewhat offset the loss on its stock portfolio. ●

This hedge is more effective when the investor's portfolio, like the S&P 500 index, is diversified. The value of a less diversified stock portfolio will correlate less with the S&P 500 index, in which case a gain from selling index futures may not completely offset the loss in the portfolio during a market downturn.

Assuming that the stock portfolio moves in tandem with the S&P 500, a full hedge would involve the sale of the amount of futures contracts whose combined underlying value is equal to the market value of the stock portfolio being hedged.

EXAMPLE Suppose that a portfolio manager has a stock portfolio valued at $400,000. In addition, assume the S&P 500 index futures contracts are available for a settlement date one month from now at a level of 1600, which is about equal to today's index value. The manager could sell S&P 500 futures contracts to hedge the stock portfolio. Since the futures contract is valued at $250 times the index level, the contract will result in a payment of $400,000 at settlement date. One index futures contract can be used to match the existing value of the stock portfolio. Assuming that the stock index moves in tandem with the manager's stock portfolio, any loss on the portfolio should be offset by a corresponding gain on the futures contract. For example, if the stock portfolio declines by about 5 percent over one month, this reflects a loss of $20,000 (0.05 × $400,000 = $20,000). Yet the S&P 500 index should also have declined by 5 percent (to a level of 1520). Therefore, the S&P 500 index futures contract that was sold by the manager should result in a gain of $20,000 [(1600 − 1520) × $250], which offsets the loss on the stock portfolio. ●

If the stock market experiences higher prices over the month, the S&P 500 index will rise and create a loss on the futures contract. However, the value of the manager's stock portfolio will have increased to offset the loss.

Most investors who had hedged their stock portfolios with index futures benefited from the hedge when the credit crisis began in 2008. In particular, hedging during the second half of the year was especially beneficial because many stocks declined by more than 30 percent during that period.

Test of Suitability of Stock Index Futures The suitability of using stock index futures to hedge can be assessed by measuring the sensitivity of the portfolio's performance to market movements over a period prior to taking a hedge position. The sensitivity of a hypothetical position in futures to those same market movements in that period could also be assessed. A general test of suitability is to determine whether the hypothetical derivative position would have offset adverse market effects on the portfolio's performance. Although it may be extremely difficult to perfectly hedge all of a portfolio's exposure to market risk, for a hedge to be suitable there should be some evidence that such a hypothetical hedge would have been moderately effective for that firm. That is, if the position in financial derivatives would not have provided an effective hedge of market risk over a recent period, a firm should not expect that it will provide an effective hedge in the future. This test of suitability uses only data that were available at the time the hedge was to be enacted.

Determining the Proportion of the Portfolio to Hedge Portfolio managers do not necessarily hedge their entire stock portfolio, because they may wish to be partially exposed in the event that stock prices rise. For instance, if the portfolio in the preceding example were valued at $1.2 million, the portfolio manager could have hedged one-third of the stock portfolio by selling one stock index futures contract. The short position in one index futures contract would reflect one-third of the stock portfolio's value. Alternatively, the manager could have hedged two-thirds of the stock portfolio by selling two stock index futures contracts. The higher the proportion of the portfolio that is hedged, the more insulated the manager's performance is from market conditions, whether those conditions are favorable or unfavorable.

Exhibit 13.7 illustrates the net gain (including the gain on the futures and the gain on the stock portfolio) to the portfolio manager under five possible scenarios for the market return (shown in the first column). If the stock market declines, any degree of hedging is beneficial, but the benefits are greater if a higher proportion of the portfolio is hedged. If the stock market performs well, any degree of hedging reduces the net gain, but the reduction is greater if a higher proportion of the portfolio is hedged. In essence, hedging with stock index futures reduces the sensitivity to both unfavorable and favorable market conditions.

Exhibit 13.7 Net Gain (on Stock Portfolio and Short Position in Stock Index Futures) for Different Degrees of Hedging

SCENARIO FOR MARKET RETURN	PROPORTION OF STOCK PORTFOLIO HEDGED			
	0%	33%	67%	100%
−20%	−20%	−13.4%	−6.7%	0%
−10	−10	−6.7	−3.3	0

Note: Numbers are based on the assumption that the stock portfolio moves in perfect tandem with the market.

13-3d Dynamic Asset Allocation with Stock Index Futures

Institutional investors are increasingly using dynamic asset allocation, in which they switch between risky and low-risk investment positions over time in response to changing expectations. This strategy allows managers to increase the exposure of their portfolios when they expect favorable market conditions and to reduce their exposure when they expect unfavorable conditions. When they anticipate favorable market movements, stock portfolio managers can purchase stock index futures, which intensify the effects of market conditions. Conversely, when they anticipate unfavorable market movements, they can sell stock index futures to reduce the effects that market conditions will have on their stock portfolios. Because expectations change frequently, it is not uncommon for portfolio managers to alter their degree of exposure. Stock index futures allow portfolio managers to alter their risk–return position without restructuring their existing stock portfolios. Using dynamic asset allocation in this way avoids the substantial transaction costs that would be associated with restructuring the stock portfolios.

13-3e Arbitrage with Stock Index Futures

The New York Stock Exchange narrowly defines program trading as the simultaneous buying and selling of at least 15 different stocks that, in aggregate, are valued at more than $1 million. Program trading is commonly used in conjunction with the trading of stock index futures contracts in a strategy known as **index arbitrage**. Securities firms act as **arbitrageurs** by capitalizing on discrepancies between prices of index futures and stocks. Index arbitrage involves the buying or selling of stock index futures with a simultaneous opposite position in the stocks that the index comprises. The index arbitrage is instigated when prices of stock index futures differ significantly from the stocks represented by the index. For example, if the index futures contract is priced high relative to the stocks representing the index, an arbitrageur may consider purchasing the stocks and simultaneously selling stock index futures. Conversely, if the index futures are priced low relative to the stocks representing the index, an arbitrageur may purchase index futures and simultaneously sell stocks. An arbitrage profit is attainable if the price differential exceeds the costs incurred from trading in both markets.

Index arbitrage does not cause the price discrepancy between the two markets but instead responds to it. The arbitrageur's ability to detect price discrepancies between the stock and futures markets is enhanced by computers. Roughly half of all program trading activity is for the purpose of index arbitrage.

Some critics suggest that the index arbitrage activity of purchasing index futures while selling stocks adversely affects stock prices. However, if index futures did not exist, institutional investors could not use portfolio insurance. In this case, a general expectation of a temporary market decline would be more likely to encourage sales of stocks to prepare for the decline, which would actually accelerate the drop in prices.

13-3f Circuit Breakers on Stock Index Futures

As mentioned in Chapter 12, *circuit breakers* are trading restrictions imposed on specific stocks or stock indexes. The CME Group imposes circuit breakers on several stock index futures, including the S&P 500 futures contract.

By prohibiting trading for short time periods when prices decline to specific threshold levels, circuit breakers may allow investors to determine whether circulating rumors are true and to work out credit arrangements if they have received a margin call. If prices are still perceived to be too high when the markets reopen, the prices will decline further. Thus circuit breakers do not guarantee that prices will turn upward. Nevertheless, they may be able to prevent large declines in prices that would be due to panic selling rather than to fundamental forces.

13-4 Single Stock Futures

A *single* stock futures contract is an agreement to buy or sell a specified number of shares of a specified stock on a specified future date. Such contracts have been traded on futures exchanges in Australia and Europe since the 1990s. The Chicago Board Options Exchange and the CME Group recently engaged in a joint venture called OneChicago, where single stock futures contracts of U.S. stocks are traded. The size of a contract is 100 shares. Investors can buy or sell singles stock futures contracts through their broker, and they can be purchased on margin. The orders to buy and sell a specific single stock futures contract are matched electronically. Single stock futures have become increasingly popular, and today are available on more than 2,200 stocks. They are regulated by the Commodity Futures Trading Commission and the Securities and Exchange Commission.

Settlement dates are on the third Friday of the delivery month on a quarterly basis (March, June, September, and December) for the next five quarters as well as for the nearest two months. For example, on January 3, an investor could purchase a stock futures contract for the third Friday in the next two months (January or February) or over the next five quarters (March, June, September, December, and March of the following year).

Investors who expect a particular stock's price to rise over time may consider buying futures on that stock. To obtain a contract to buy March futures on 100 shares of Zyco stock for $5,000 ($50 per share), an investor must submit the $5,000 payment to the clearinghouse on the third Friday in March and will receive shares of Zyco stock on the settlement date. If Zyco stock is valued at $53 at the time of settlement, the investor can sell the stock in the stock market for a gain of $3 per share or $300 for the contract (ignoring commissions). This gain would likely reflect a substantial return on the investment, since the investor had to invest only a small margin (perhaps 20 percent of the contract price) to take a position in futures. If Zyco stock is valued at $46 at the time of settlement, the investor would incur a loss of $4 share, which would reflect a substantial percentage loss on the investment. Thus, single stock futures offer potential high returns but also high risk.

Investors who expect a particular stock's price to decline over time can sell futures contracts on that stock. This activity is similar to selling a stock short, except that single stock futures can be sold without borrowing the underlying stock from a broker (as short-sellers must do). To obtain a contract to sell March futures of Zyco stock, an investor must deliver Zyco stock to the clearinghouse on the third Friday in March and will receive the payment specified in the futures contract.

Investors can close out their position at any time by taking the opposite position. Suppose that, shortly after the investor purchased futures on Zyco stock with a March

delivery at $50 per share, the stock price declines. Rather than incur the risk that the price could continue to decline, the investor could sell a Zyco futures contract with a March delivery. If this contract specifies a price of $48 per share, the investor's gain will be the difference between the selling price and the buying price, which is −$2 per share or −$200 for the contract.

Recently, futures contracts for exchange-traded funds (ETFs) have also been introduced. These allow an investor to buy or sell a particular ETF at a specified price. More information about ETFs is provided in Chapter 23.

13-5 Risk of Trading Futures Contracts

Users of futures contracts must recognize the various types of risk exhibited by such contracts and other derivative instruments.

13-5a Market Risk

Market risk refers to fluctuations in the value of the instrument as a result of market conditions. Firms that use futures contracts to speculate should be concerned about market risk. If their expectations about future market conditions are wrong, they may suffer losses on their futures contracts. Firms that use futures contracts to hedge are less concerned about market risk because if market conditions cause a loss on their derivative instruments, they should have a partial offsetting gain on the positions that they were hedging.

13-5b Basis Risk

A second type of risk is basis risk, or the risk that the position being hedged by the futures contracts is not affected in the same manner as the instrument underlying the futures contract. This type of risk applies only to those firms or individuals who are using futures contracts to hedge. The change in the value of the futures contract position may not move in perfect tandem with the change in value of the portfolio that is being hedged, so the hedge might not perfectly hedge the risk of the portfolio.

13-5c Liquidity Risk

A third type of risk is liquidity risk, which refers to potential price distortions due to a lack of liquidity. For example, a firm may purchase a particular bond futures contract to speculate on expectations of rising bond prices. However, when it attempts to close out its position by selling an identical futures contract, it may find that there are no willing buyers for this type of futures contract at that time. In this case, the firm will have to sell the futures contract at a lower price. Users of futures contracts may reduce liquidity risk by using only those futures contracts that are widely traded.

13-5d Credit Risk

A fourth type of risk is **credit risk**, which is the risk that a loss will occur because a counterparty defaults on the contract. This type of risk exists for over-the-counter transactions, in which a firm or individual relies on the creditworthiness of a counterparty.

The credit risk of counterparties is not a concern when trading futures and other derivatives on exchanges, because the exchanges normally guarantee that the provisions of the contract will be honored. The financial intermediaries that make the arrangements in the over-the-counter market can also take some steps to reduce this type of risk. First, the financial intermediary can require that each party provide some form of collateral to back up its position. Second, the financial intermediary can serve (for a fee) as a guarantor in the event that the counterparty does not fulfill its obligation.

13-5e Prepayment Risk

Prepayment risk refers to the possibility that the assets to be hedged may be prepaid earlier than their designated maturity. Suppose that a commercial bank sells Treasury bond futures in order to hedge its holdings of corporate bonds and that, just after the futures position is created, the bonds are called by the corporation that initially issued them. If interest rates subsequently decline, the bank will incur a loss from its futures position without a corresponding gain from its bond position (because the bonds were called earlier).

As a second example, consider a savings and loan association with large holdings of long-term, fixed-rate mortgages that are mostly financed by short-term funds. It sells Treasury bond futures to hedge against the possibility of rising interest rates; then, after the futures position is established, interest rates decline and many of the existing mortgages are prepaid by homeowners. The savings and loan association will incur a loss from its futures position without a corresponding gain from its fixed-rate mortgage position (because the mortgages were prepaid).

13-5f Operational Risk

A sixth type of risk is operational risk, which is the risk of losses as a result of inadequate management or controls. For example, firms that use futures contracts to hedge are exposed to the possibility that the employees responsible for their futures positions do not fully understand how values of specific futures contracts will respond to market conditions. Furthermore, those employees may take more speculative positions than the firms desire if the firms do not have adequate controls to monitor them.

EXAMPLE

The case of MF Global Holdings serves as a good example of operational risk. During 2011, it experienced major losses from its speculative positions, and it pulled funds from its customer accounts to cover its losses. It ultimately experienced liquidity problems and went bankrupt in October 2011. The funds that it pulled from customer accounts were not repaid. A few months later, another brokerage firm for futures traders (Peregine Financial Group) also experienced liquidity problems, as its actual bank cash balance was more than $100 million less than what it had reported. It ultimately filed for bankruptcy in July 2012. These events triggered concerns about the exposure of traders to financial fraud in the futures markets. ●

13-5g Exposure of Futures Market to Systemic Risk

To the extent that traders of financial futures contracts or other derivative securities are unable to cover their derivative contract obligations in over-the-counter transactions, they could cause financial problems for their respective counterparties. This could expose the futures market to systemic risk whereby the intertwined relationships among firms may cause one trader's financial problems to be passed on to other traders (if there is not enough collateral backing the contracts).

EXAMPLE

Nexus, Inc., requests several transactions in derivative securities that involve buying futures on Treasury bonds in an over-the-counter market. Bangor Bank accommodates Nexus by taking the opposite side of the transactions. The bank's positions in these contracts also serve as a hedge against its existing exposure to interest rate risk. As time passes, Nexus experiences financial problems. As interest rates rise and the value of a Treasury bond futures contract declines, Nexus will take a major loss on the futures transactions. It files for bankruptcy, since it is unable to fulfill its obligation to buy the Treasury bonds from Bangor Bank at the settlement date. Bangor Bank was relying on this payment to hedge its exposure to interest rate risk. Consequently, Bangor Bank experiences financial problems and cannot make the payments on other over-the-counter derivatives contracts that it has with three other financial institutions. These financial institutions were

relying on those funds to cover their own obligations on derivative contracts with several other firms. These firms may then be unable to honor their payment obligations resulting from the derivative contract agreements, causing the adverse effects to spread further. ●



The credit crisis in 2008 and 2009 demonstrated that some financial institutions had high exposure to risk because their derivative security positions were intended to enhance profits rather than to hedge portfolio risk. Since then, regulators have become more aware of the potential systemic risk.

The Financial Reform Act in 2010 resulted in the creation of the Financial Stability Oversight Council, which is responsible for identifying risks to financial stability in the United States and making regulatory recommendations that could reduce any risks to the financial system. The council consists of ten members who head regulatory agencies overseeing key components of the financial system (including the CFTC, which regulates financial futures trading).

13-6 Globalization of Futures Markets



The trading of financial futures also requires the assessment of international financial market conditions. The flow of foreign funds into and out of the United States can affect interest rates and therefore the market value of Treasury bonds, corporate bonds, mortgages, and other long-term debt securities. Portfolio managers assess international flows of funds to forecast changes in interest rate movements, which in turn affect the value of their respective portfolios. Even speculators assess international flows of funds to forecast interest rates so that they can determine whether to take short or long futures positions.

13-6a Non-U.S. Participation in U.S. Futures Contracts

Financial futures contracts on U.S. securities are commonly traded by non-U.S. financial institutions that maintain holdings of U.S. securities. These institutions use financial futures to reduce their exposure to movements in the U.S. stock market or interest rates.

13-6b Foreign Stock Index Futures

Foreign stock index futures have been created both for speculating on and hedging against potential movements in foreign stock markets. Expectations of a strong foreign stock market encourage the purchase of futures contracts on the representative index. Conversely, if firms expect a decline in the foreign market, they will consider selling futures on the representative index. Financial institutions with substantial investments in a particular foreign stock market can hedge against a temporary decline in that market by selling foreign stock index futures.

Some of the more popular foreign stock index futures contracts are identified in Exhibit 13.8. Numerous other foreign stock index futures contracts have been created. In fact, futures exchanges have been established in Ireland, France, Spain, and Italy. Financial institutions around the world can use futures contracts to hedge against temporary declines in their asset portfolios. Speculators can take long or short positions to speculate on a particular market with a relatively small initial investment. Financial futures on debt instruments (such as futures on German government bonds) are also offered by numerous exchanges in non-U.S. markets, including the London International Financial Futures Exchange (LIFFE), Singapore International Monetary Exchange (SIMEX), and Sydney Futures Exchange (SFE). In 2001, the LIFFE was acquired by Euronext, an alliance of European stock exchanges.

Exhibit 13.8 Popular Foreign Stock Index Futures Contracts

NAME OF STOCK FUTURES INDEX	DESCRIPTION
Nikkei 225	225 Japanese stocks
Toronto 35	35 stocks on Toronto stock exchange
Financial Times Stock Exchange 100	100 stocks on London stock exchange
Barclays share price	40 stocks on New Zealand stock exchange
Hang Seng	33 stocks on Hong Kong stock exchange
Osaka	50 Japanese stocks
All Ordinaries share price	307 Australian stocks

Electronic trading of futures contracts is creating an internationally integrated futures market. As mentioned previously, the CME Group has instituted Globex, a round-the-world electronic trading network. It allows financial futures contracts to be traded even when the trading floor is closed.

13-6c Currency Futures Contracts

A currency futures contract is a standardized agreement to deliver or receive a specified amount of a specified foreign currency at a specified price (exchange rate) and date. The settlement months are March, June, September, and December. Some companies act as hedgers in the currency futures market by purchasing futures on currencies that they will need in the future to cover payables or by selling futures on currencies that they will receive in the future. Speculators in the currency futures market may purchase futures on a foreign currency that they expect to strengthen against the U.S. dollar or sell futures on currencies that they expect to weaken against the U.S. dollar.

Purchasers of currency futures contracts can hold the contract until the settlement date and accept delivery of the foreign currency at that time, or they can close out their long position prior to the settlement date by selling the identical type and number of contracts before then. If they close out their long position, their gain or loss is determined by the difference between the futures price when they created the position and the futures price at the time the position was closed out. Sellers of currency futures contracts either deliver the foreign currency at the settlement date or close out their position by purchasing an identical type and number of contracts prior to the settlement date.

Summary

- A financial futures contract is a standardized agreement to deliver or receive a specified amount of a specified financial instrument at a specified price and date. Financial institutions such as commercial banks, savings institutions, bond mutual funds, pension funds, and insurance companies trade interest rate futures contracts to hedge their exposure to interest rate risk. Some stock mutual funds, pension funds, and insurance companies trade stock index futures to hedge their exposure to adverse stock market movements.
- An interest rate futures contract locks in the price to be paid for a specified debt instrument. Speculators who expect interest rates to decline can purchase interest rate futures contracts, because the market value of the underlying debt instrument should rise. Speculators who expect interest rates to rise can sell interest rate futures contracts, because the

market value of the underlying debt instrument should decrease.

- Financial institutions (or other firms) that desire to hedge against rising interest rates can sell interest rate futures contracts. Financial institutions that desire to hedge against declining interest rates can purchase these contracts. If interest rates move in the anticipated direction, the financial institutions will gain from their futures position, which can partially offset any adverse effects of the interest rate movements on their normal operations.
- Speculators who expect stock prices to increase can purchase stock index futures contracts; speculators who expect stock prices to decrease can sell these contracts. Stock index futures can be sold by financial institutions that expect a temporary decline in stock prices and wish to hedge their stock portfolios.
- A single stock futures contract is an agreement to buy or sell a specified number of shares of a specified stock on a specified future date. The trading of single stock futures is regulated by the Commodity Futures Trading Commission (CFTC) and the Securities and Exchange Commission (SEC).
- Investors who expect a particular stock's price to rise over time may consider buying futures on that stock. Investors who expect a particular stock's price to decline over time can sell futures contracts on that stock. This activity is similar to selling a stock short, but single stock futures can be sold without borrowing the underlying stock from a broker. Investors can close out their position at any time by taking the opposite position.
- Traders in the futures market may be exposed to market risk, basis risk, liquidity risk, credit risk, prepayment risk, and operational risk. The over-the-counter trading of futures contracts and other derivative securities can expose the entire financial system to systemic risk, in which the trading losses of one firm could spread to others if collateral is not sufficient to cover losses. The Financial Reform Act in 2010 resulted in the creation of the Financial Stability Oversight Council, which is responsible for making recommendations that could reduce any risks to the financial system. The council includes the head of the Commodity Futures Trading Commission, which regulates financial futures trading.

Point Counter-Point

Has the Futures Market Created More Uncertainty for Stocks?

Point Yes. Futures contracts encourage speculation on indexes. Thus, an entire market can be influenced by the trading of speculators.

Counter-Point No. Futures contracts are commonly used to hedge portfolios and therefore can reduce the effects of weak market conditions. Moreover, investing in stocks is just as speculative as taking a position in futures markets.

Who Is Correct? Use the Internet to learn more about this issue and then formulate your own opinion.

Questions and Applications

1. **Futures Contracts** Describe the general characteristics of a futures contract. How does a clearinghouse facilitate the trading of financial futures contracts?

2. **Futures Pricing** How does the price of a financial futures contract change as the market price of the security it represents changes? Why?

3. **Hedging with Futures** Explain why some futures contracts may be more suitable than others for hedging exposure to interest rate risk.

4. **Treasury Bond Futures** Will speculators buy or sell Treasury bond futures contracts if they expect interest rates to increase? Explain.

5. **Gains from Purchasing Futures** Explain how purchasers of financial futures contracts can offset their position. How is their gain or loss determined? What is the maximum loss to a purchaser of a futures contract?

6. **Gains from Selling Futures** Explain how sellers of financial futures contracts can offset their position. How is their gain or loss determined?

7. Hedging with Futures Assume a financial institution has more rate-sensitive assets than rate-sensitive liabilities. Would it be more likely to be adversely affected by an increase or a decrease in interest rates? Should it purchase or sell interest rate futures contracts in order to hedge its exposure?

8. Hedging with Futures Assume a financial institution has more rate-sensitive liabilities than rate-sensitive assets. Would it be more likely to be adversely affected by an increase or a decrease in interest rates? Should it purchase or sell interest rate futures contracts in order to hedge its exposure?

9. Hedging Decision Why do some financial institutions remain exposed to interest rate risk, even when they believe that the use of interest rate futures could reduce their exposure?

10. Long versus Short Hedge Explain the difference between a long hedge and a short hedge used by financial institutions. When is a long hedge more appropriate than a short hedge?

11. Impact of Futures Hedge Explain how the probability distribution of a financial institution's returns is affected when it uses interest rate futures to hedge. What does this imply about its risk?

12. Cross-Hedging Describe the act of cross-hedging. What determines the effectiveness of a cross-hedge?

13. Hedging with Bond Futures How might a savings and loan association use Treasury bond futures to hedge its fixed-rate mortgage portfolio (assuming that its main source of funds is short-term deposits)? Explain how prepayments on mortgages can limit the effectiveness of the hedge.

14. Stock Index Futures Describe stock index futures. How could they be used by a financial institution that is anticipating a jump in stock prices but does not yet have sufficient funds to purchase large amounts of stock? Explain why stock index futures may reflect investor expectations about the market more quickly than stock prices.

15. Selling Stock Index Futures Why would a pension fund or insurance company consider selling stock index futures?

16. Systemic Risk Explain systemic risk as it relates to the futures market. Explain how the Financial Reform Act of 2010 attempts to monitor systemic risk in the futures market and other markets.

17. Circuit Breakers Explain the use of circuit breakers.

Advanced Questions

18. Hedging with Futures Elon Savings and Loan Association has a large number of 30-year mortgages with floating interest rates that adjust on an annual basis and obtains most of its funds by issuing five-year certificates of deposit. It uses the yield curve to assess the market's anticipation of future interest rates. It believes that expectations of future interest rates are the major force affecting the yield curve. Assume that a downward-sloping yield curve with a steep slope exists. Based on this information, should Elon consider using financial futures as a hedging technique? Explain.

19. Hedging Decision Blue Devil Savings and Loan Association has a large number of 10-year fixed-rate mortgages and obtains most of its funds from short-term deposits. It uses the yield curve to assess the market's anticipation of future interest rates. It believes that expectations of future interest rates are the major force affecting the yield curve. Assume that an upward-sloping yield curve with a steep slope exists. Based on this information, should Blue Devil consider using financial futures as a hedging technique? Explain.

20. How Futures Prices May Respond to Prevailing Conditions Consider the prevailing conditions for inflation (including oil prices), the economy, the budget deficit, and other conditions that could affect the values of futures contracts. Based on these conditions, would you prefer to buy or sell Treasury bond futures at this time? Would you prefer to buy or sell stock index futures at this time? Assume that you would close out your position at the end of this semester. Offer some logic to support your answers. Which factor is most influential on your decision regarding Treasury bond futures and on your decision regarding stock index futures?

21. Use of Interest Rate Futures When Interest Rates Are Low Short-term and long-term interest rates are presently very low. You believe that the Fed will use a monetary policy to maintain interest rates at a very low level. Do you think financial institutions that could be adversely affected by a decline in interest rates would benefit from hedging their exposure with interest rate futures? Explain.

Interpreting Financial News

Interpret the following statements made by Wall Street analysts and portfolio managers.

a. "The existence of financial futures contracts allows our firm to hedge against temporary market declines without liquidating our portfolios."

b. "Given my confidence in the market, I plan to use stock index futures to increase my exposure to market movements."

c. "We used currency futures to hedge the exchange rate exposure of our international mutual fund focused on German stocks."

Managing in Financial Markets

Managing Portfolios with Futures Contracts As a portfolio manager, you are monitoring previous investments that you made in stocks and bonds of U.S. firms and in stocks and bonds of Japanese firms. Though you plan to keep all of these investments over the long run, you are willing to hedge against adverse effects on your investments that result from economic conditions. You expect that, over the next year, U.S. and Japanese interest rates will decline, the U.S. stock market will perform poorly, the Japanese stock market will perform well, and the Japanese yen (the currency) will depreciate against the dollar.

a. Should you consider taking a position in U.S. bond index futures to hedge your investment in U.S. bonds? Explain.

b. Should you consider taking a position in Japanese bond index futures to hedge your investment in Japanese bonds? Explain.

c. Should you consider taking a position in U.S. stock index futures to hedge your investment in U.S. stocks? Explain.

d. Should you consider taking a position in Japanese stock index futures to hedge your investment in Japanese stocks? (Note: The Japanese stock index is denominated in yen and therefore is used to hedge stock movements, not currency movements.)

e. Should you consider taking a position in Japanese yen futures to hedge the exchange rate risk of your investment in Japanese stocks and bonds?

PROBLEMS

1. Profit from T-Bill Futures Spratt Company purchased T-bill futures contracts when the quoted price was 93.50. When this position was closed out, the quoted price was 94.75. Determine the profit or loss per contract, ignoring transaction costs.

2. Profit from T-Bill Futures Suerth Investments, Inc., purchased T-bill futures contracts when the quoted price was 95.00. When this position was closed out, the quoted price was 93.60. Determine the profit or loss per contract, ignoring transaction costs.

3. Profit from T-Bill Futures Toland Company sold T-bill futures contracts when the quoted price was 94.00. When this position was closed out, the quoted price was 93.20. Determine the profit or loss per contract, ignoring transaction costs.

4. Profit from T-Bill Futures Rude Dynamics, Inc., sold T-bill futures contracts when the quoted price was 93.26. When this position was closed out, the quoted price was 93.90. Determine the profit or loss per contract, ignoring transaction costs.

5. Profit from T-Bond Futures Egan Company purchased a futures contract on Treasury bonds that specified a price of 91-00. When the position was closed out, the price of the Treasury bond futures contract was 90-10. Determine the profit or loss, ignoring transaction costs.

6. Profit from T-Bond Futures R. C. Clark sold a futures contract on Treasury bonds that specified a price of 92-10. When the position was closed out, the price of the Treasury bond futures contract was 93-00. Determine the profit or loss, ignoring transaction costs.

7. Profit from Stock Index Futures Marks Insurance Company sold S&P 500 stock index futures that specified an index of 1690. When the position was closed out, the index specified by the futures contract was 1720. Determine the profit or loss, ignoring transaction costs.

Flow of Funds Exercise

Hedging with Futures Contracts

Recall that if the economy continues to be strong, Carson Company may need to increase its production capacity by about 50 percent over the next few years to satisfy demand. It would need financing to expand and accommodate the increase in production. Recall that the yield curve is currently upward sloping. Also recall that Carson is concerned about a possible slowing of the economy because of potential Fed actions to reduce inflation. Carson currently relies mostly on commercial loans with floating interest rates for its debt financing.

a. How could Carson use futures contracts to reduce the exposure of its cost of debt to interest rate movements? Be specific about whether it would use a snort hedge or a long hedge.

b. Will the hedge that you described in the previous question perfectly offset the increase in debt costs if interest rates increase? Explain what drives the profit from the short hedge, versus what drives the higher cost of debt to Carson, if interest rates increase.

Internet/Excel Exercises

1. Go to http://futuresource.quote.com and review the charts for an equity index product such as the S&P 500. Explain how the price pattern moved recently.

2. Now compare that pattern to the actual trend of the S&P 500, which is provided at the Yahoo! Finance website (finance.yahoo.com). Describe the relationship between the movements in S&P 500 futures and movements in the S&P 500 index.

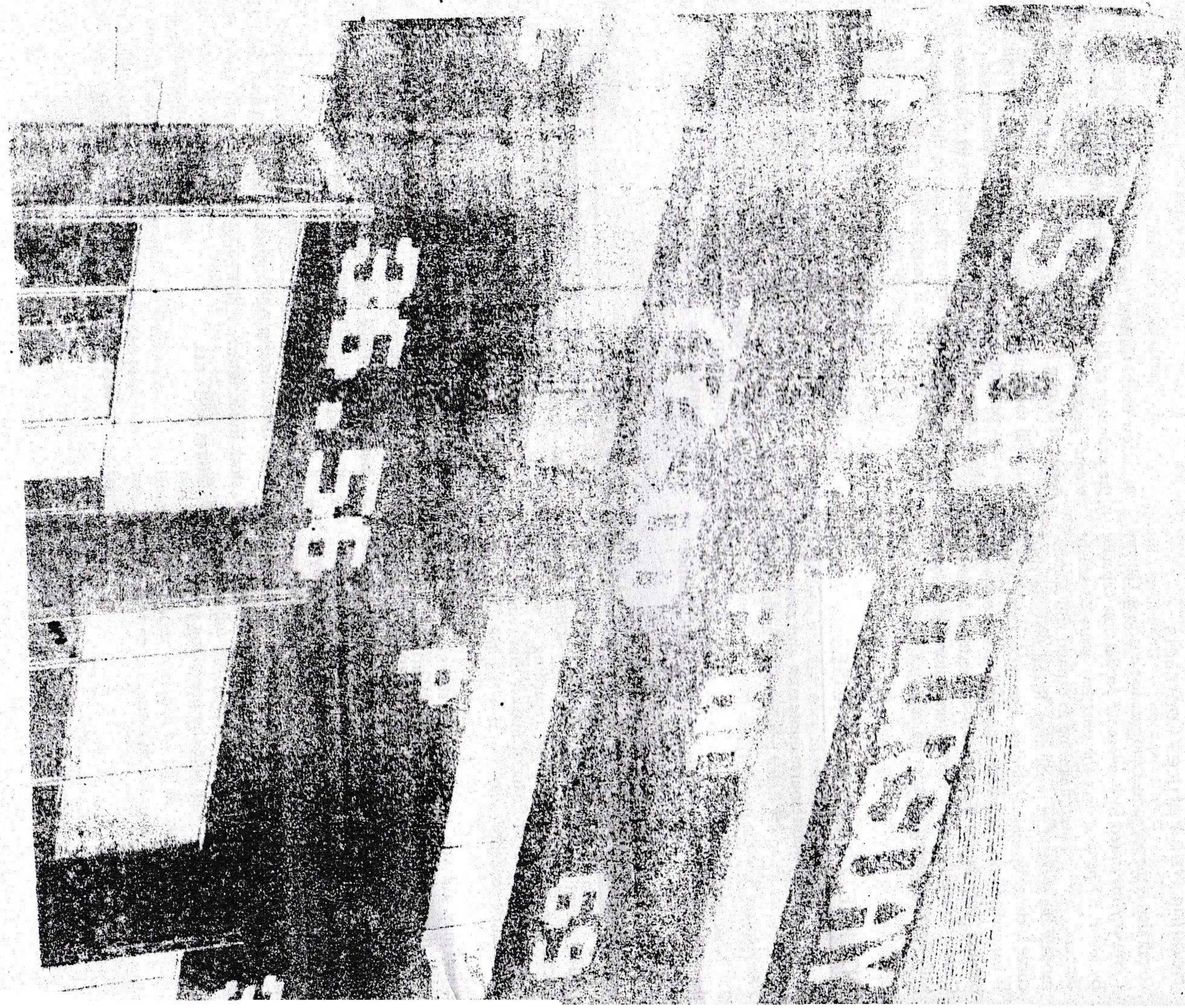
Online Articles with Real-World Examples

Find a recent practical article available online that describes a real-world example regarding a specific financial institution or financial market that reinforces one or more concepts covered in this chapter.

If your class has an online component, your professor may ask you to post your summary of the article there and provide a link to the article so that other students can access it. If your class is live, your professor may ask you to summarize your application of the article in class. Your professor may assign specific students to complete this assignment or may allow any students to do the assignment on a volunteer basis.

For recent online articles and real-world examples related to this chapter, consider using the following search terms (be sure to include the prevailing year as a search term to ensure that the online articles are recent):

1. interest rate futures AND investment
2. interest rate futures AND gains
3. interest rate futures AND losses
4. interest rate futures AND speculators
5. interest rate futures AND hedge
6. stock index futures AND gains
7. stock index futures AND losses
8. stock index futures AND speculators
9. stock index futures AND hedge
10. futures AND risk



14 Option Markets

CHAPTER OBJECTIVES

The specific objectives of this chapter are to:

- provide a background on options,
- explain why stock option premiums vary,
- explain how stock options are used to speculate,
- explain how stock options are used to hedge,
- explain the use of stock index options, and
- explain the use of options on futures.

Stock options can be used by speculators to benefit from their expectations and by financial institutions to reduce their risk. Options markets facilitate the trading of stock options.

14-1 Background on Options

Options are classified as *calls* or *puts*. A **call option** grants the owner the right to purchase a specified financial instrument (such as a stock) for a specified price (called the **exercise price** or **strike price)** within a specified period of time.

A call option is said to be **in the money** when the market price of the underlying security exceeds the exercise price, **at the money** when the market price is equal to the exercise price, and **out of the money** when it is below the exercise price.

The second type of option is known as a **put option**. It grants the owner the right to sell a specified financial instrument for a specified price within a specified period of time. As with call options, owners pay a premium to obtain put options. They can exercise the options at any time up to the expiration date but are not obligated to do so.

A put option is said to be "in the money" when the market price of the underlying security is below the exercise price, "at the money" when the market price is equal to the exercise price, and "out of the money" when it exceeds the exercise price.

Call and put options specify 100 shares for the stocks to which they are assigned. Premiums paid for call and put options are determined by the participants engaged in trading. The premium for a particular option changes over time as it becomes more or less desirable to traders.

Participants can close out their option positions by making an offsetting transaction. For example, purchasers of an option can offset their positions at any time by selling an identical option. The gain or loss is determined by the premium paid when purchasing the option versus the premium received when selling an identical option. Sellers of options can close out their positions at any time by purchasing an identical option.

The stock options just described are known as *American-style* stock options. They can be exercised at any time until the expiration date. In contrast, *European-style* stock options can be exercised only just before expiration.

In addition to options on stocks there are options on stock indexes, which allow investors the right to buy (with a call option) or sell (with a put option) a specified stock index for a specified price up to a specified expiration date. There are also options on interest rate futures contracts, which allow investors the right to buy or sell a

www.cboe.com
The volume of calls versus the volume of puts are used to assess their respective popularity.

specified interest rate futures contract for a specified price up to a specified expiration date. Options on stock indexes and on interest rate futures are covered later in this chapter.

14-1a Comparison of Options and Futures

There are two major differences between purchasing an option and purchasing a futures contract. First, to obtain an option, a premium must be paid in addition to the price of the financial instrument. Second, the owner of an option can choose to let the option expire on the expiration date without exercising it. Call options grant a right, but not an obligation, to purchase a specified financial instrument. In contrast, buyers of futures contracts are obligated to purchase the financial instrument at a specified date. If the owner does exercise the call option, the seller (sometimes called the **writer**) of the option is obligated to provide the specified financial instrument at the price specified by the option contract if the owner exercises the option. Sellers of call options receive an up-front fee (the premium) from the purchaser as compensation.

biz.yahoo.com/opt
Daily coverage of options market activity.

14-1b Markets Used to Trade Options

The Chicago Board Options Exchange (CBOE), which was created in 1973, is the most important exchange for trading options. It serves as a market for options on more than 2,000 different stocks. The options listed on the CBOE have a standardized format, as will be explained shortly. The standardization of the contracts on the CBOE proved to be a major advantage because it allowed for easy trading of existing contracts (a secondary market). With standardization, the popularity of options increased and the options became more liquid. Since there were numerous buyers and sellers of the standardized contracts, buyers and sellers of a particular option contract could be matched.

Options are also traded at the CME Group, which was formed in July 2007 by the merger of the Chicago Board of Trade (CBOT) and the Chicago Mercantile Exchange (CME). As discussed in Chapter 13, the CME Group serves international markets for derivative products. To increase efficiency and reduce operating and maintenance expenses after the merger, the CME Group consolidated the CME and CBOT trading floors into a single trading floor at the CBOT and consolidated the products of the CME and CBOT on a single electronic platform. Transactions of new derivative products typically are executed by the CME Group's electronic platform.

As the popularity of stock options increased, various stock exchanges began to list options. In particular, the American Stock Exchange (acquired by NYSE Euronext in 2008), the Nasdaq, and the Philadelphia Stock Exchange (acquired by Nasdaq in 2008) list options on many different stocks. So does the International Securities Exchange, which was the first fully electronic U.S. options exchange. Today, any particular options contract may be traded on various exchanges, and competition among the exchanges may result in more favorable prices for customers.

Some specialized option contracts are sold "over the counter," rather than on an exchange, whereby a financial intermediary (such as a commercial bank or an investment bank) finds a counterparty or serves as the counterparty. These over-the-counter arrangements are more personalized and can be tailored to the specific preferences of the parties involved. Such tailoring is not possible for the more standardized option contracts sold on the exchanges.

Listing Requirements Each exchange has its own requirements concerning the stocks for which it creates options. One key requirement is a minimum trading volume of the underlying stock, since the volume of options traded on a particular stock will

normally be higher if the stock trading volume is high. The decision to list an option is made by each exchange, not by the firms represented by the options contracts.

Role of the Options Clearing Corporation Like a stock transaction, the trading of an option involves a buyer and a seller. The sale of an option imposes specific obligations on the seller under specific conditions. The exchange itself does not take positions in option contracts, but provides a market where the options can be bought or sold. The Options Clearing Corporation (OCC) serves as a guarantor on option contracts traded in the United States, which means that the buyer of an option contract does not have to be concerned that the seller will back out of the obligation.

Regulation of Options Trading Options trading is regulated by the Securities and Exchange Commission and by the various option exchanges. The regulation is intended to ensure fair and orderly trading. For example, it attempts to prevent insider trading (trading based on information that insiders have about their firms and that is not yet disclosed to the public). It also attempts to prevent price fixing among floor brokers that could cause wider bid-ask spreads that would impose higher costs on customers.

14-1c How Option Trades Are Executed

When options exchanges were created, floor brokers of exchanges were available to execute orders for brokerage firms. They went to a specific location on the trading floor where the option was traded to execute the order. Today, computer technology allows investors to have trades executed electronically. Most small, standardized transactions are executed electronically, whereas complex transactions are executed by competitive open outcry among exchange members. Many electronic communication networks (ECNs) are programmed to consider all possible trades and execute the order at the best possible price.

Market-makers can also execute stock option transactions for customers. They earn the difference between the bid price and the ask price for this trade, although the spread has declined significantly in recent years. Market-makers also generate profits or losses when they invest their own funds in options.

14-1d Types of Orders

As with stocks, an investor can use either a market order or a limit order for an option transaction. A market order will result in the immediate purchase or sale of an option at its prevailing market price. With a limit order, the transaction will occur only if the market price is no higher or lower than a specified price limit. For example, an investor may request the purchase of a specific option only if it can be purchased at or below some specified price. Conversely, an investor may request to sell an option only if it can be sold for some specified limit or more.

Online Trading Option contracts can also be purchased or sold online. Many online brokerage firms, including E*Trade and TD Ameritrade, facilitate options orders. Online option contract orders are commonly routed to computerized networks on options exchanges, where they are executed. For these orders, computers handle the order from the time it is placed until it is executed.

14-1e Stock Option Quotations

Financial newspapers and other financial media publish quotations for stock options. Exhibit 14.1 provides an example of stock options for Viperon Company stock as of

Exhibit 14.1 Viperon Company Stock Option Quotations

	STRIKE	EXP.	VOLUME	CALL	VOLUME	PUT
Option 1	45	Jun	180	4½	60	2¾
Option 2	45	Oct	70	5¾	120	3¾
Option 3	50	Jun	360	1⅛	40	5⅛
Option 4	50	Oct	90	3½	40	6½

May 1, when the stock was priced at about $45.62 per share. There are normally more options on each stock than what is disclosed in financial newspapers, with additional exercise prices and expiration dates. Each row represents a specific option on Viperon stock. The first data column lists the exercise (strike) price, and the second column lists the expiration date. (The expiration date for stock options traded on the CBOE is the Saturday following the third Friday of the specified month.) The third and fourth columns show the volume and the most recently quoted premium of the call option with that exercise price and expiration date. The fifth and sixth columns show the volume and the most recently quoted premium of the put option with that exercise price and expiration date.

WEB

biz.yahoo.com/opt
Summary of the most actively tråded stock options.

A comparison of the premiums among the four options illustrates how specific factors affect option premiums. First, comparing Options 1 and 3 (to control for the same expiration date) reveals that an option with a higher exercise price has a lower call option premium and a higher put option premium. A comparison of Options 2 and 4 confirms this relationship. Second, comparing Options 1 and 2 (to control for the same exercise price) reveals that an option with a longer term to maturity has a higher call option premium and a higher put option premium. A comparison of Options 3 and 4 confirms this relationship.

14-1f Institutional Use of Options

Exhibit 14.2 summarizes the use of options by various types of financial institutions. Although options positions are sometimes taken by financial institutions for speculative purposes, they are more commonly used for hedging. Savings institutions and bond mutual funds use options to hedge interest rate risk. Stock mutual funds, insurance companies, and pension funds use stock index options and options on stock index futures to hedge their stock portfolios. Some of the large commercial banks often serve as an intermediary between two parties that take derivative positions in an over-the-counter market.

14-2 Determinants of Stock Option Premiums

Stock option premiums are determined by market forces. Any characteristic of an option that results in many willing buyers but few willing sellers will place upward pressure on the option premium. Thus the option premium must be sufficiently high to equalize the demand by buyers and the supply that sellers are willing to sell. This generalization applies to both call options and put options. The specific characteristics that affect the demand and supply conditions, and therefore affect the stock option premiums, are described in what follows.

Exhibit 14.2 Institutional Use of Options Markets

TYPE OF FINANCIAL INSTITUTION	PARTICIPATION IN OPTIONS MARKETS
Commercial banks	• Sometimes offer options to businesses.
Savings institutions	• Sometimes take positions in options on futures contracts to hedge interest rate risk.
Mutual funds	• Stock mutual funds take positions in stock index options to hedge against a possible decline in prices of stocks in their portfolios. • Stock mutual funds sometimes take speculative positions in stock index options in an attempt to increase their returns. • Bond mutual funds sometimes take positions in options on futures to hedge interest rate risk.
Securities firms	• Serve as brokers by executing stock option transactions for individuals and businesses.
Pension funds	• Take positions in stock index options to hedge against a possible decline in prices of stocks in their portfolio. • Take positions in options on futures contracts to hedge their bond portfolios against interest rate movements.
Insurance companies	• Take positions in stock index options to hedge against a possible decline in prices of stocks in their portfolio. • Take positions in options on futures contracts to hedge their bond portfolios against interest rate movements.

14-2a Determinants of Call Option Premiums

Call option premiums are affected primarily by the following factors:

- Market price of the underlying instrument (relative to the option's exercise price)
- Volatility of the underlying instrument
- Time to maturity of the call option

Influence of the Market Price The higher the existing market price of the underlying financial instrument relative to the exercise price, the higher the call option premium, other things being equal. A stock's value has a higher probability of increasing well above the exercise price if it is already close to or above the exercise price. Thus a purchaser would be willing to pay a higher premium for a call option on such a stock.

The influence of the market price of a stock (relative to the exercise price) on the call option premium can also be understood by comparing stock options with different exercise prices on the same instrument at a given time.

EXAMPLE Consider the data shown in Exhibit 14.3 for KSR call options quoted on February 25, with a similar expiration date. The stock price of KSR was about $140 at that time. The premium for the call option with the $130 exercise price was almost $10 higher than the premium for the option with the $150 exercise price. This example confirms that a higher premium is required to lock in a lower exercise price on call options. ●

Influence of the Stock's Volatility The greater the volatility of the underlying stock, the higher the call option premium, other things being equal. If a stock is volatile, there is a higher probability that its price will increase well above the exercise price. Thus a purchaser would be willing to pay a higher premium for a call option on that stock. For instance, call options on small stocks normally have higher premiums than call options on large stocks because small stocks are typically more volatile.

Exhibit 14.3 Relationship between Exercise Price and Call Option Premium on KSR Stock

EXERCISE PRICE	PREMIUM FOR APRIL EXPIRATION DATE
$130	11⅝
135	7½
140	5¼
145	3¼
150	1⅞

Influence of the Call Option's Time to Maturity The longer the call option's time to maturity, the higher the call option premium, other things being equal. A longer time period until expiration allows the owner of the option more time to exercise the option. Thus there is a higher probability that the stock's price will move well above the exercise price before the option expires.

The relationship between the time to maturity and the call option premium is illustrated in Exhibit 14.4 for KSR call options quoted on February 25, with a similar exercise price of $135. The premium was $4.50 per share for the call option with a March expiration month versus $7.50 per share for the call option with an April expiration month. The difference reflects the additional time in which the April call option can be exercised.

14-2b Determinants of Put Option Premiums

The premium paid on a put option depends on the same factors that affect the premium paid on a call option. However, the direction of influence varies for one of the factors, as explained next.

Influence of the Market Price The higher the existing market price of the underlying stock relative to the exercise price, the lower the put option premium, all other things being equal. A stock's value has a higher probability of decreasing well below the exercise price if it is already close to or below the exercise price. Thus a purchaser would be willing to pay a higher premium for a put option on that stock. This influence on the put option premium differs from the influence on the call option premium because, from the perspective of put option purchasers, a *lower* market price is preferable.

The influence of the market price of a stock (relative to the exercise price) on the put option premium can also be understood by comparing options with different exercise prices on the same instrument at a given moment in time. For example, consider the data shown in Exhibit 14.5 for KSR put options with a similar expiration date quoted

Exhibit 14.4 Relationship between Time to Maturity and Call Option Premium on KSR Stock

EXPIRATION DATE	PREMIUM FOR OPTION WITH A $135 EXERCISE PRICE
March	4½
April	7½
July	13¼

Exhibit 14.5 Relationship between Exercise Price and Put Option Premium on KSR Stock

EXERCISE PRICE	PREMIUM FOR JUNE EXPIRATION DATE
$130	1⅞
135	3⅛
140	5⅜
145	8½
150	12¼

on February 25, 2010. The premium for the put option with the $150 exercise price was more than $9 per share higher than the premium for the option with the $135 exercise price. The difference reflects the more favorable price at which the stock can be sold when holding the put option with the higher exercise price.

Influence of the Stock's Volatility The greater the volatility of the underlying stock, the higher the put option premium, all other things being equal. This relationship also held for call option premiums. If a stock is volatile, there is a higher probability of its price deviating far from the exercise price. Thus a purchaser would be willing to pay a higher premium for a put option on that stock because its market price is more likely to decline well below the option's exercise price.

Influence of the Put Option's Time to Maturity The longer the time to maturity, the higher the put option premium, all other things being equal. This relationship also held for call option premiums. A longer time period until expiration allows the owner of the option more time to exercise the option. Thus there is a higher probability that the stock's price will move well below the exercise price before the option expires.

The relationship between the time to maturity and the put option premium is shown in Exhibit 14.6 for KSR put options with a similar exercise price of $135 quoted on February 25, 2010. The premium was $7.25 per share for the put option with a July expiration month versus $0.50 per share for the put option with a March expiration month. This difference reflects the additional time during which the put option with the July expiration date can be exercised.

14-2c How Option Pricing Can Be Used to Derive a Stock's Volatility

The general relationships between the determinants described previously and the option premium are explained in the text of this chapter, but see the Appendix for discussion of a well-known formula used to price stock options. Since the anticipated volatility of a

Exhibit 14.6 Relationship between Time to Maturity and Put Option Premium on KSR Stock

EXPIRATION DATE	PREMIUM FOR OPTION WITH A $135 EXERCISE PRICE
March	½
April	3⅛
July	7¼

stock is not observable, investors can input their own estimate of it when calculating the premium that should be paid for a particular option.

Some investors who are assessing a specific stock's risk adapt the option-pricing formula to derive an estimate of that stock's anticipated volatility. By plugging in values for the other factors that affect the particular stock option's premium and for the prevailing premium quoted in the market, it is possible to derive the stock's anticipated volatility, which is referred to as the *implied standard deviation* (or *implied volatility*). The implied standard deviation is derived by determining what its value must be, given the quoted option premium and the values of other factors that affect the stock option's premium. Various software packages and calculators are available that can estimate a stock's implied volatility. Such an estimate is of interest to investors because it indicates the market's view of the stock's potential volatility. Some investors may use this estimate as a measure of a stock's risk when they consider what stocks to purchase.

14-2d Explaining Changes in Option Premiums

Exhibit 14.7 identifies the underlying forces that cause option prices to change over time. Economic conditions and market conditions can cause abrupt changes in the stock price or in the anticipated volatility of the stock price over the time remaining until option expiration. Such changes would have a major impact on the stock option's premium.

Indicators Monitored by Participants in the Options Market Since the premiums paid on stock options are highly influenced by the price movements of the underlying stocks, participants in the stock option market closely monitor the same indicators that are monitored when trading the underlying stocks. Traders of options tend to monitor economic indicators because economic conditions affect cash flows of firms and thus can affect expected stock valuations and stock option premiums. Economic conditions can also affect the premiums by influencing expected stock volatility.

EXAMPLE

During the fall of 2008, the credit crisis intensified and stock volatility increased substantially. Consequently, premiums for options increased as well. Under these conditions, more portfolio managers wanted to hedge their stock positions, but they had to pay a higher premium for put options. The sellers of put options recognized that their risk had increased because of the higher volatility and priced the put options accordingly.

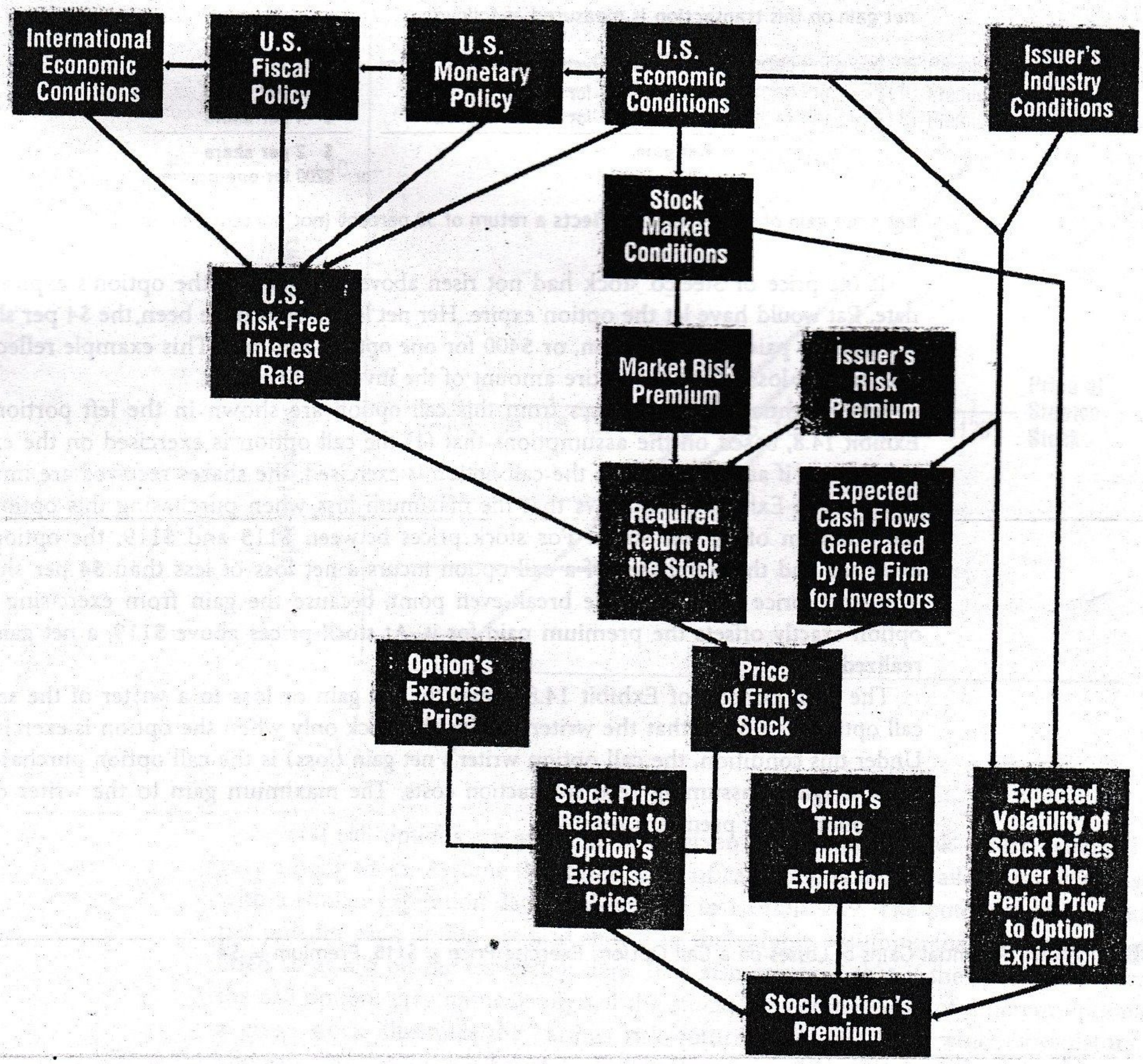
In the years after the financial crisis, stock volatility declined. Consequently, the sellers of put options were exposed to a lower level of risk, and were more willing to accept a lower premium. ●

14-3 Speculating with Stock Options

Stock options are frequently traded by investors who are attempting to capitalize on their expectations. When investors purchase an option that does not cover (hedge) their existing investments, the option can be referred to as "naked" (uncovered). Since speculators trade options to gamble on price movements rather than to hedge existing investments, their positions in options are naked. Whether speculators purchase call options or put options depends on their expectations.

In some cases, speculators borrow a portion of the funds that they use to invest in stock options. The use of borrowed funds can magnify their gains, but it can also magnify their losses. The gains and losses described in this chapter would be more

Exhibit 14.7 Framework for Explaining Why a Stock Option's Premium Changes over Time



pronounced if the speculators cited in the examples used borrowed funds for a portion of their investment.

14-3a Speculating with Call Options

Call options can be used to speculate on the expectation of an increase in the price of the underlying stock.

EXAMPLE

Pat Jackson expects Steelco stock to increase from its current price of $113 per share but does not want to tie up her available funds by investing in stocks. She purchases a call option on Steelco with

an exercise price of $115 for a premium of $4 per share. Before the option's expiration date, Steelco's price rises to $121. At that time, Jackson exercises her option, purchasing shares at $115 per share. She then immediately sells those shares at the market price of $121 per share. Her net gain on this transaction is measured as follows:

Amount received when selling shares	$121 per share
− Amount paid for shares	− $115 per share
− Amount paid for the call option	− $ 4 per share
= Net gain	$ 2 per share
	or $200 for one contract

Pat's net gain of $2 per share reflects a return of 50 percent (not annualized). ●

If the price of Steelco stock had not risen above $115 before the option's expiration date, Pat would have let the option expire. Her net loss would have been the $4 per share she initially paid for the option, or $400 for one option contract. This example reflects a 100 percent loss, since the entire amount of the investment is lost.

The potential gains or losses from this call option are shown in the left portion of Exhibit 14.8, based on the assumptions that (1) the call option is exercised on the expiration date, if at all, and (2) if the call option is exercised, the shares received are immediately sold. Exhibit 14.8 shows that the maximum loss when purchasing this option is the premium of $4 per share. For stock prices between $115 and $119, the option is exercised and the purchaser of a call option incurs a net loss of less than $4 per share. The stock price of $119 is the break-even point, because the gain from exercising the option exactly offsets the premium paid for it. At stock prices above $119, a net gain is realized.

The right portion of Exhibit 14.8 shows the net gain or loss to a writer of the same call option, assuming that the writer obtains the stock only when the option is exercised. Under this condition, the call option writer's net gain (loss) is the call option purchaser's net loss (gain), assuming zero transaction costs. The maximum gain to the writer of a call option is the premium received.

Exhibit 14.8 Potential Gains or Losses on a Call Option: Exercise Price = $115, Premium = $4

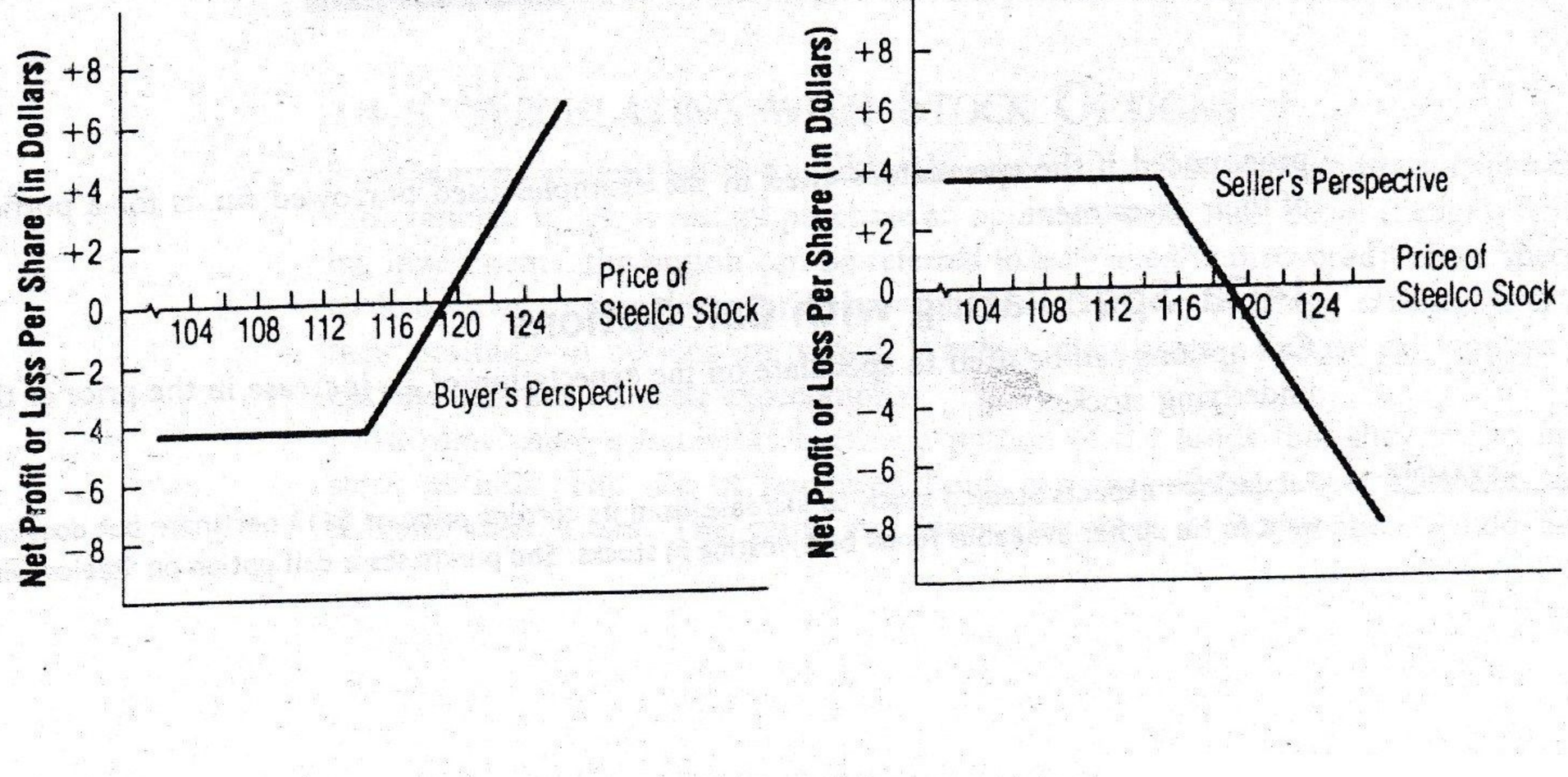
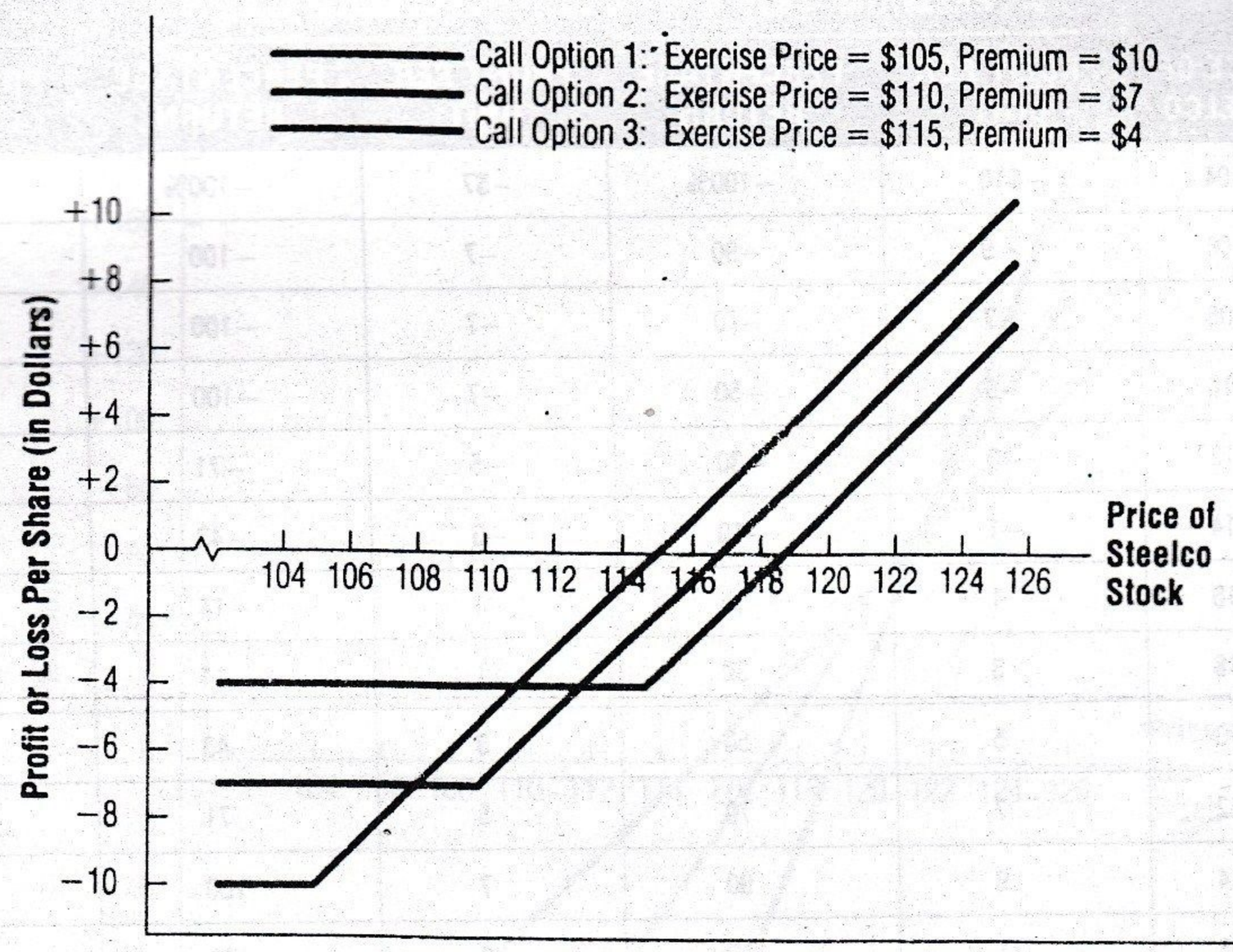


Exhibit 14.9 Potential Gains or Losses for Three Call Options (Buyer's Perspective)



Several call options are available for a given stock, and the risk–return potential will vary among them. Assume that three types of call options were available on Steelco stock with a similar expiration date, as described in Exhibit 14.9. The potential gains or losses per unit for each option are also shown in the exhibit, assuming that the option is exercised (if at all) on the expiration date. It is also assumed that if the speculators exercise the call option, they immediately sell the stock. This comparison of different options for a given stock illustrates the various risk–return trade-offs from which speculators can choose.

Purchasers of call options are normally most interested in returns (profit as a percentage of the initial investment) under various scenarios. For this purpose, the contingency graph can be revised to reflect returns for each possible price per share of the underlying stock. The first step is to convert the profit per unit into a return for each possible price, as shown in Exhibit 14.10. For example, for the stock price of $116, Call Option 1 generates a return of 10 percent ($1 per share profit as a percentage of the $10 premium paid), Call Option 2 generates a loss of about 14 percent ($1 per share loss as a percentage of the $7 premium paid), and Call Option 3 generates a loss of 75 percent ($3 per share loss as a percentage of the $4 premium paid).

The data can be transformed into a contingency graph as shown in Exhibit 14.11. This graph illustrates that, for Call Option 1, both the potential losses and the potential returns in the event of a high stock price are relatively low. Conversely, the potential losses for Call Option 3 are relatively high but so are the potential returns in the event of a high stock price.

Exhibit 14.10 Potential Returns on Three Different Call Options

	OPTION 1: EXERCISE PRICE = $105, PREMIUM = $10		OPTION 2: EXERCISE PRICE = $110, PREMIUM = $7		OPTION 3: EXERCISE PRICE = $115, PREMIUM = $4	
PRICE OF STEELCO	PROFIT PER UNIT	PERCENTAGE RETURN	PROFIT PER UNIT	PERCENTAGE RETURN	PROFIT PER UNIT	PERCENTAGE RETURN
$104	−$10	−100%	−$7	−100%	−$4	−100%
106	−9	−90	−7	−100	−4	−100
108	−7	−70	−7	−100	−4	−100
110	−5	−50	−7	−100	−4	−100
112	−3	−30	−5	−71	−4	−100
114	−1	−10	−3	−43	−4	−100
116	1	10	−1	−14	−3	−75
118	3	30	1	14	−1	−25
120	5	50	3	43	1	25
122	7	70	5	71	3	75
124	9	90	7	100	5	125
126	11	110	9	129	7	175

14-3b Speculating with Put Options

Put options can be used to speculate on the expectation of a decrease in the price of the underlying stock.

EXAMPLE

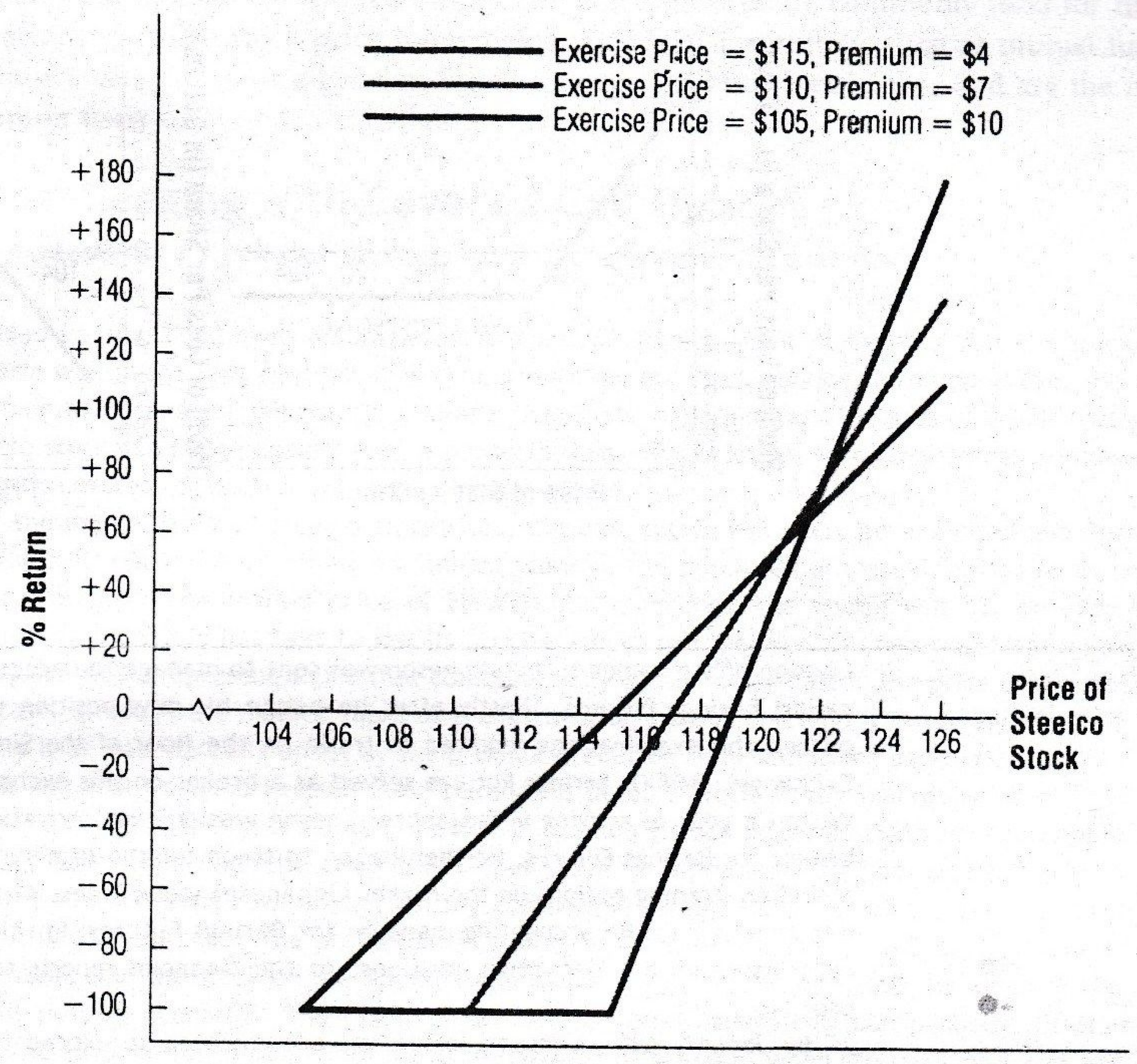
A put option on Steelco is available with an exercise price of $110 and a premium of $2. If the price of Steelco stock falls below $110, speculators could purchase the stock and then exercise their put options to benefit from the transaction. However, they would need to make at least $2 per share on this transaction to fully recover the premium paid for the option. If the speculators exercise the option when the market price is $104, their net gain is measured as follows:

Amount received when selling shares	$110 per share
− Amount paid for shares	− $104 per share
− Amount paid for the put option	− $ 2 per share
= Net gain	$ 4 per share

The net gain here is 200 percent, or twice as much as the amount paid for the put options. ●

The potential gains or losses from the put option described here are shown in the left portion of Exhibit 14.12, based on the assumptions that (1) the put option is exercised on the expiration date, if at all, and (2) the shares would be purchased just before the put option is exercised. The exhibit shows that the maximum loss when purchasing this option is $2 per share. For stock prices between $108 and $110, the purchaser of a put option incurs a net loss of less than $2 per share. The stock price of $108 is the break-even point, because the gain from exercising the put option would exactly offset the $2 per share premium.

Exhibit 14.11 Potential Returns for Three Call Options (Buyer's Perspective)



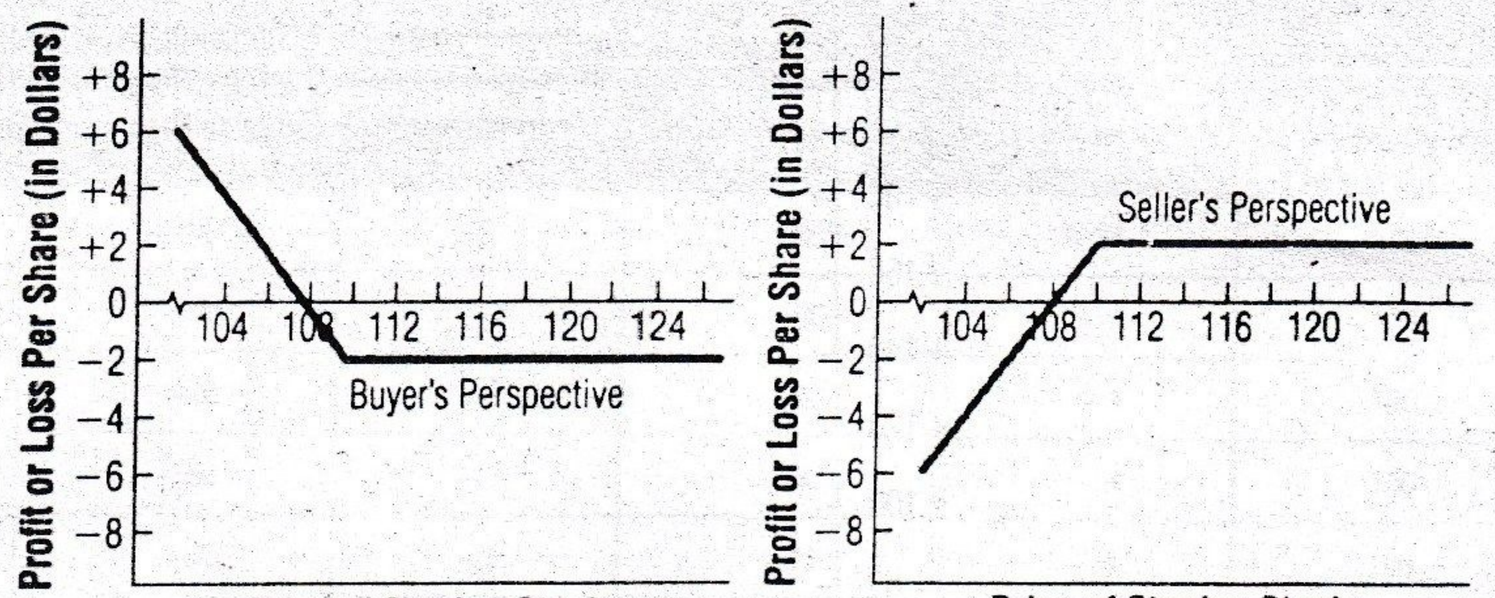
The right portion of Exhibit 14.12 shows the net gain or loss to a writer of the same put option, assuming that the writer sells the stock received as the put option is exercised. Under this condition, the put option writer's net gain (loss) is the put option purchaser's net loss (gain), assuming zero transaction costs. The maximum gain to the writer of a put option is the premium received. As with call options, several put options are typically available for a given stock, and the potential gains or losses will vary among them.

14-3c Excessive Risk from Speculation

Speculating in options can be very risky. Financial institutions or other corporations that speculate in options normally have methods to closely monitor their risk and to measure their exposure to possible option market conditions. In several cases, however, a financial institution or a corporation incurred a major loss on options positions because of a lack of oversight over its options trading.

EXAMPLE One of the most famous cases in which a financial institution took excessive risk with stock options is Barings PLC, an investment bank in the United Kingdom. In 1992, a clerk in Barings's

Exhibit 14.12 Potential Gains or Losses on a Put Option: Exercise Price = $110, Premium = $2



London office named Nicholas Leeson was sent to manage the accounting at a Singapore subsidiary called Barings Futures. Shortly after he began his new position in Singapore, Leeson took and passed the examinations required to trade on the floor of the Singapore International Monetary Exchange (SIMEX). Barings Futures served as a broker on this exchange for some of its customers. Within a year of arriving in Singapore, Leeson was trading derivative contracts on the SIMEX as a broker for Barings Futures. He then began to trade for the firm's own account rather than just as a broker, trading options on the Nikkei (Japanese) stock index. At the same time, he also continued to serve as the accounting manager for Barings Futures. In this role Leeson was able to conceal losses on any derivative positions, so the financial reports to Barings PLC showed massive profits.

By January 1995, Leeson's losses had accumulated to exceed the equivalent of $300 million. Leeson had periodically required funds to cover margin calls as his positions declined in value. Barings PLC met these funding requests, covering the equivalent of millions of dollars to satisfy the margin calls, yet did not recognize that the margin calls signaled a major problem.

In late February 1995, an accounting clerk at Barings who noticed some discrepancies met with Leeson to reconcile the records. When Leeson was asked to explain specific accounting entries, he excused himself from the meeting and never returned. He left Singapore that night and faxed his resignation to Barings PLC from Kuala Lumpur, Malaysia. Barings PLC investigated and found that Leeson had accumulated losses totaling more than the equivalent of $1 billion, which caused Barings PLC to become insolvent. Leeson pleaded guilty to charges of fraud, and he was sentenced to prison for six and one-half years. ●

Any firms that use futures or other derivative instruments can draw a few obvious lessons from the Barings collapse. First, firms should closely monitor the trading of derivative contracts by their employees to ensure that derivatives are being used within the firm's guidelines. Second, firms should separate the reporting function from the trading function so that traders cannot conceal trading losses. Third, when firms receive margin calls on derivative positions, they should recognize that there may be potential losses on their derivative instruments and should closely evaluate those positions. The Barings case was a wake-up call to many firms, which recognized the need to establish guidelines for their employees who take derivative positions and to monitor more closely the actions of these employees.

14-4 Hedging with Stock Options

Call and put options on selected stocks and stock indexes are commonly used for hedging against possible stock price movements. Financial institutions such as mutual funds, insurance companies, and pension funds manage large stock portfolios and are the most common users of options for hedging.

14-4a Hedging with Covered Call Options

Call options on a stock can be used to hedge a position in that stock.

EXAMPLE

Portland Pension Fund owns a substantial amount of Steelco stock. It expects that the stock will perform well in the long run, but it is concerned that the stock may perform poorly over the next few months because of temporary problems Steelco is experiencing. The sale of a call option on Steelco stock can hedge against such a potential loss. This is known as a covered call because the option is covered, or backed, by stocks already owned.

If the market price of Steelco stock rises, the call option will likely be exercised and Portland will fulfill its obligation by selling its Steelco stock to the purchaser of the call option at the exercise price. But if the market price of Steelco stock declines, the option will not be exercised. Hence Portland would not have to sell its Steelco stock, and the premium received from selling the call option would represent a gain that could partially offset the decline in the price of the stock. In this case, although the market value of the institution's stock portfolio is adversely affected, the decline is at least partially offset by the premium received from selling the call option.

Assume that Portland Pension Fund purchased Steelco stock at the market price of $112 per share. To hedge against a temporary decline in Steelco's stock price, Portland sells call options on Steelco stock with an exercise price of $110 per share for a premium of $5 per share. The net profit to Portland when using covered call writing is shown in Exhibit 14.13 for various possible scenarios. For comparison purposes, the profit that Portland would earn if it did not use covered call writing but instead sold the stock on the option's expiration date is also shown (see the diagonal line) for various possible scenarios. The results show how covered call writing can partially offset losses when the stock performs poorly but can also partially offset gains when the stock performs well. ●

The table in Exhibit 14.13 explains the profit or loss per share from covered call writing. At any price above $110 per share as of the expiration date, the call option would be exercised and so Portland would have to sell its holdings of Steelco stock at the exercise price of $110 per share to the purchaser of the call option. The net gain to Portland would be $3 per share, determined as the premium of $5 per share (received when writing the option) minus the $2 per share difference between the price paid for the Steelco stock and the price at which the stock is sold. Comparing the profit or loss per scenarios with and without covered call writing, it is clear that covered call writing limits the upside potential return on stocks but also reduces the risk.

14-4b Hedging with Put Options

Put options on stock are also used to hedge stock positions.

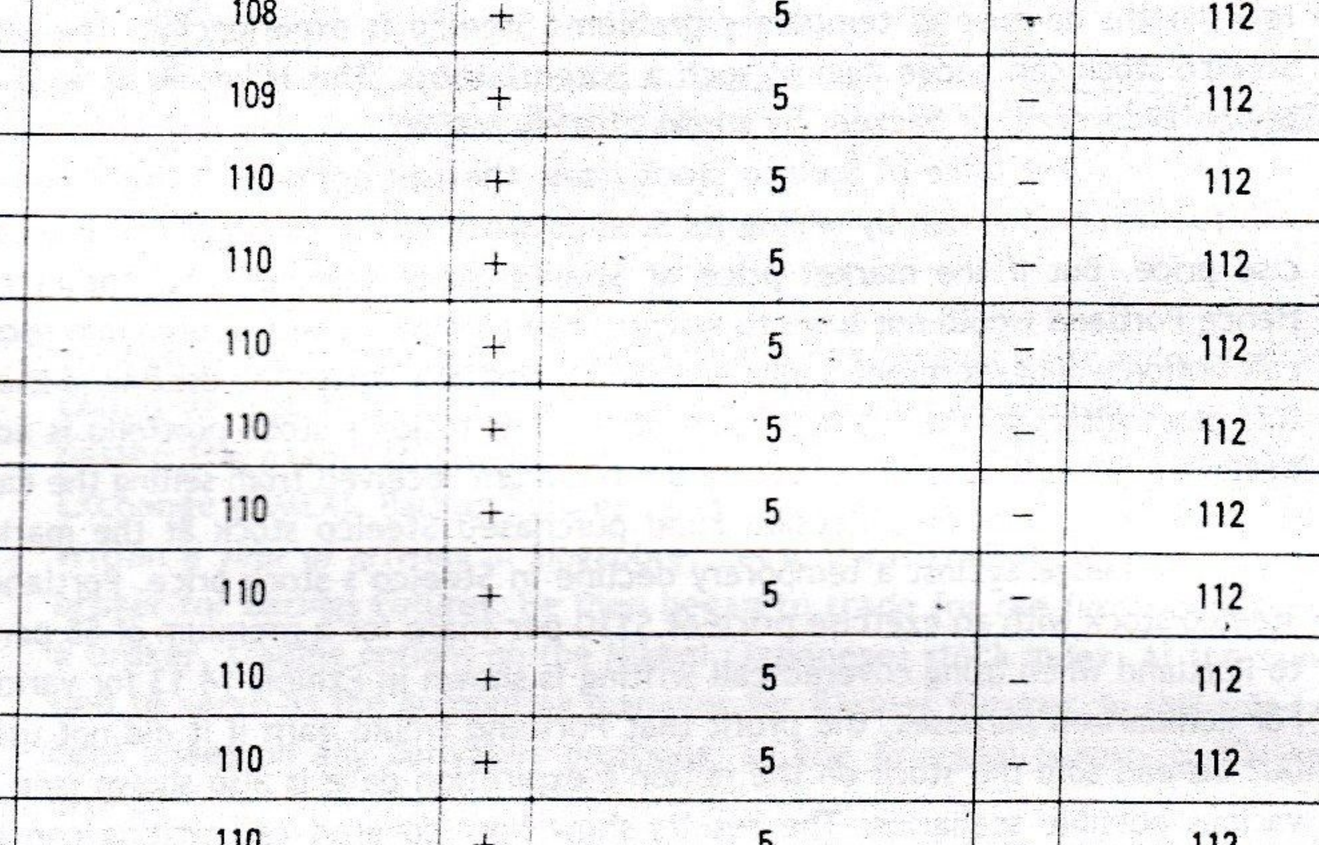
EXAMPLE

Reconsider the example in which Portland Pension Fund was concerned about a possible temporary decline in the price of Steelco stock. Portland could hedge against a temporary decline in Steelco's stock price by purchasing put options on that stock. In the event that Steelco's stock price declines, Portland would likely generate a gain on its option position, which would help offset the reduction in the stock's price. If Steelco's stock price does not decline, Portland would not exercise its put option. ●

Put options are typically used to hedge when portfolio managers are mainly concerned about a temporary decline in a stock's value. When portfolio managers are

Exhibit 14.13 Risk-Return Trade-off from Covered Call Writing

EXPLANATION OF PROFIT PER SHARE FROM COVERED CALL WRITING							
MARKET PRICE PAID FOR STEELCO STOCK	PRICE AT WHICH PORTLAND PENSION FUND SELLS STEELCO CALL OPTION		PREMIUM RECEIVED FOR WRITING COVERED CALL		PRICE PAID FOR STEELCO STOCK		PROFIT OR LOSS PER SHARE
$104	$104	+	$5	−	$112	=	−$3
105	105	+	5	−	112	=	−2
106	106	+	5	−	112	=	−1
107	107	+	5	−	112	=	0
108	108	+	5	−	112	=	1
109	109	+	5	−	112	=	2
110	110	+	5	−	112	=	3
111	110	+	5	−	112	=	3
112	110	+	5	−	112	=	3
113	110	+	5	−	112	=	3
114	110	+	5	−	112	=	3
115	110	+	5	−	112	=	3
116	110	+	5	−	112	=	3
117	110	+	5	−	112	=	3
118	110	+	5	−	112	=	3
119	110	+	5	−	112	=	3
120	110	+	5	−	112	=	3



mainly concerned about the long-term performance of a stock, they are likely to sell the stock itself rather than hedge the position.

Hedging with LEAPs **Long-term equity anticipations (LEAPs)** are options that have longer terms to expiration, usually between two and three years from the initial listing date. These options are available for some large capitalization stocks, and they may be a more effective hedge over a longer term period than using options with shorter terms to expiration. The transaction costs for hedging over a long period are lower than the costs of continually repurchasing short-term put options each time the options expire or are exercised. Furthermore, the costs of continually repurchasing put options are uncertain, whereas the costs of purchasing a put option on a long-term index option are known immediately.

14-5 Options on ETFs and Stock Indexes

Options are also traded on exchange-traded funds (ETFs) and stock indexes. Exchange-traded funds are funds that are designed to mimic particular indexes and are traded on an exchange. Thus, an ETF option provides the right to trade a specified ETF at a specified price by a specified expiration date. Since ETFs are traded like stocks, options on ETFs are traded like options on stocks. Investors who exercise a call option on an ETF will receive delivery of the ETF in their account. Investors who exercise a put option on an ETF will have the ETF transferred from their account to the counterparty on the put option.

A **stock index option** provides the right to trade a specified stock index at a specified price by a specified expiration date. Call options on stock indexes allow the right to purchase the index, and put options on stock indexes allow the right to sell the index. If and when the index option is exercised, the cash payment is equal to a specified dollar amount multiplied by the difference between the index level and the exercise price.

Options on stock indexes are similar to options on ETFs. However, the values of stock indexes change only at the end of each trading day, whereas ETF values can change throughout the day. Therefore, an investor who wants to capitalize on the expected movement of an index within a particular day will trade options on ETFs. An investor who wants to capitalize on the expected movement of an index over a longer period of time (such as a week or several months) can trade options on either ETFs or indexes.

Options on indexes have become popular for speculating on general movements in the stock market. Speculators who anticipate a sharp increase in stock market prices overall may consider purchasing call options on one of the market indexes. Likewise, speculators who anticipate a stock market decline may consider purchasing put options on these indexes. A sampling of options that are traded on ETFs and on stock indexes is provided in Exhibit 14.14, where SPDR stands for Standard & Poor's Depositary Receipts.

Options on sector indexes also exist, allowing investors the option to buy or sell an index that reflects a particular sector. These contracts are distinguished from stock index options because they represent a component of a stock index. Investors who are optimistic about the stock market in general might be more interested in stock index options, while investors who are especially optimistic about one particular sector may be more interested in options on a sector index. There are options available for many different sectors, including banking, energy, housing, oil exploration, semiconductors, and utilities.

14-5a Hedging with Stock Index Options

Financial institutions and other firms commonly take positions in options on ETFs or indexes to hedge against market or sector conditions that would adversely affect their

Exhibit 14.14 Sampling of ETFs and Indexes on Which Options Are Traded

SAMPLING OF ETFs ON WHICH OPTIONS ARE TRADED	
iShares Nasdaq Biotechnology	iShares Russell 1000 Growth Index Fund
iShares Goldman Sachs Technology Index	Energy Select Sector SPDR
iShares Goldman Sachs Software Index	Financial Select Sector SPDR
iShares Russell 1000 Index Fund	Utilities Select Sector SPDR
iShares Russell 1000 Value Index Fund	Health Care Select Sector SPDR
SAMPLING OF INDEXES ON WHICH OPTIONS ARE TRADED	
Asia 25 Index	S&P SmallCap 600 Index
Euro 25 Index	Nasdaq 100 Index
Mexico Index	Russell 1000 Index
Dow Jones Industrial Average	Russell 1000 Value Index
Dow Jones Transportation Average	Russell 1000 Growth Index
Dow Jones Utilities Average	Russell Midcap Index
S&P 100 Index	Goldman Sachs Internet Index
S&P 500 Index	Goldman Sachs Software Index
Morgan Stanley Biotechnology Index	

asset portfolio or cash flows. The following discussion is based on the use of options on stock indexes, but options on ETFs could be used in the same manner.

Financial institutions such as insurance companies and pension funds maintain large stock portfolios whose values are driven by general market movements. If the stock portfolio is broad enough, any changes in its value will likely be highly correlated with market movements. For this reason, portfolio managers consider purchasing put options on a stock index to protect against stock market declines. The put options should be purchased on the stock index that most closely mirrors the portfolio to be hedged. If the stock market experiences a severe downturn, the market value of the portfolio declines. However, the put options on the stock index will generate a gain because the value of the index will be less than the exercise price. The greater the market downturn, the greater the decline in the market value of the portfolio but also the greater the gain from holding put options on a stock index. Thus, this offsetting effect minimizes the overall impact on the firm.

If the stock market rises, the put options on the stock index will not be exercised. In this case, the firm will not recover the cost of purchasing the options. This situation is similar to purchasing other forms of insurance and then not using them. Some portfolio managers may still believe the options were worthwhile for temporary protection against downside risk.

Hedging with Long-Term Stock Index Options Long-term equity anticipations are used by option market participants who want options with longer terms until

expiration. For example, LEAPs on the S&P 100 and S&P 500 indexes are available, with expiration dates extending at least two years ahead from the initial listing date. Each of these indexes is revised to one-tenth its normal size when applying LEAPs. The result is smaller premiums, which makes the LEAPs more affordable to smaller investors.

Dynamic Asset Allocation with Stock Index Options Dynamic asset allocation involves switching between risky and low-risk investment positions over time in response to changing expectations. Some portfolio managers use stock index options as a tool for dynamic asset allocation. For example, when portfolio managers anticipate favorable market conditions, they purchase call options on a stock index, which intensify the effects of the market conditions. Essentially, the managers are using stock index options to increase their exposure to stock market conditions. Conversely, when they anticipate unfavorable market movements, they can purchase put options on a stock index in order to reduce the effects that market conditions will have on their stock portfolios.

Because stock options are available with various exercise prices, portfolio managers can select an exercise price that provides the degree of protection desired. For example, assume an existing stock index is quite similar to a manager's stock portfolio and that he wants to protect against any loss exceeding 5 percent. If the prevailing level of the index is 400, the manager should purchase put options with an exercise price of 380 because that level is 5 percent lower than 400. If the index declines to a level below 380, the manager will exercise the options and the gain from doing so will partially offset the reduction in the stock portfolio's market value.

This strategy is essentially a form of insurance, where the premium paid for the put option is similar to an insurance premium. Because the index must decline by 5 percent before there is any possibility that the option will be exercised, this is similar to the "deductible" that is typical of insurance policies. If portfolio managers desire to protect against even smaller losses, they can purchase a put option that specifies a higher exercise price on the index, such as 390. To obtain the extra protection, however, they would have to pay a higher premium for the option. In other words, the cost of the portfolio insurance would be higher because of the smaller "deductible" desired.

In another form of dynamic asset allocation, portfolio managers sell (write) call options on stock indexes in periods when they expect the stock market to be stable. This strategy does not create a perfect hedge, but it can enhance the portfolio's performance in periods when stock prices are stagnant or declining.

Portfolio managers can adjust the risk–return profile of their investment position by using stock index options rather than restructuring their existing stock portfolios. This form of dynamic asset allocation avoids the substantial transaction costs associated with restructuring the stock portfolios.

14-5b Using Index Options to Measure the Market's Risk

Just as a stock's implied volatility can be derived from information about options on that stock, a stock index's implied volatility can be derived from information about options on that stock index. The same factors that affect the option premium on a stock affect the option premium on an index. Thus, the premium on an index option is positively related to the expected volatility of the underlying stock index. If investors want to estimate the expected volatility of the stock index, they can use software packages to insert values for the prevailing option premium and all the other factors (except volatility) that affect an option premium.

The CBOE volatility index (VIX) represents the implied volatility derived from options on the S&P 500 index (an index of 500 large stocks). This index is closely monitored by many investors because it indicates the market's anticipated volatility for the market (with the S&P 500 serving as proxy for the market). The VIX is sometimes referred to as the "fear index" because high values are perceived to reflect a high degree of fear that stock prices could decline.

14-6 Options on Futures Contracts

In recent years, the concept of options has been applied to futures contracts to create options on futures contracts (sometimes referred to as "futures options"). An option on a particular futures contract gives its owner the right (but not an obligation) to purchase or sell that futures contract for a specified price within a specified period of time. Thus, options on futures grant the power to take the futures position if favorable conditions occur but the flexibility to avoid the futures position (by letting the option expire) if unfavorable conditions occur. As with other options, the purchaser of options on futures pays a premium.

Similarly, options are available on stock index futures. They are used for speculating on expected stock market movements or hedging against adverse market conditions. Individuals and financial institutions use them in a manner similar to the way stock index options are used.

Options are also available on interest rate futures, such as Treasury note futures or Treasury bond futures. The settlement dates of the underlying futures contracts are usually a few weeks after the expiration date of the corresponding options contracts.

A call option on interest rate futures grants the right to purchase a futures contract at a specified price within a specified period of time. A put option on financial futures grants the right (again, not an obligation) to sell a particular financial futures contract at a specified price within a specified period of time. Because interest rate futures contracts can hedge interest rate risk, options on interest rate futures might be considered by any financial institution that is exposed to that risk, including savings institutions, commercial banks, life insurance companies, and pension funds.

14-6a Speculating with Options on Futures

Speculators who anticipate a change in interest rates should also expect a change in bond prices. They could take a position in options on Treasury bond futures to capitalize on their expectations.

Speculation Based on an Expected Decline in Interest Rates If speculators expect a decline in interest rates, they may consider purchasing a call option on Treasury bond futures. If their expectations are correct, the market value of Treasury bonds will rise and the price of a Treasury bond futures contract will rise as well. The speculators can exercise their option to purchase futures at the exercise price, which will be lower than the value of the futures contract.

EXAMPLE Kelly Warden expects interest rates to decline and purchases a call option on Treasury bond futures. The exercise price on Treasury bond futures is 94-32 (9432/64 percent of $100,000, or $94,500). The call option is purchased at a premium of 2-00 (i.e., 2 percent of $100,000), which equals $2,000. Assume that interest rates do decline and, as a result, the price of the Treasury bond futures contract rises over time to a value of 99-00 ($99,000) shortly before the option's expiration date. At this time, Kelly decides to exercise the option and closes out the position by selling an

identical futures contract (to create an offsetting position) at a higher price than the price at which she purchased the futures. Kelly's net gain from this speculative strategy is

Selling price of T-bond futures	$99,000	(99.00% of $100,000)
– Purchase price of T-bond futures	– $94,500	(94.50% of $100,000)
– Call option premium paid	– $ 2,000	(2.00% of $100,000)
= Net gain to purchaser of call option of futures	$ 2,500	(2.50% of $100,000)

This net gain of $2,500 represents a return on investment of 125 percent. ●

The seller of the call option will have the opposite position to the buyer. Thus the gain (or loss) to the buyer will equa loss (or gain) to the seller of the call option.

EXAMPLE Ellen Rose sold the call option purchased by Kelly Warden in the previous example. Ellen is obligated to purchase and provide the futures contract at the time the option is exercised. Her net gain from this speculative strategy is

Selling price of T-bond futures	$94,500	(94.50% of $100,000)
– Purchase price of T-bond futures	– $99,000	(99.00% of $100,000)
– Call option premium received	+ $ 2,000	(2.00% of $100,000)
= Net gain to Seller of call option of futures	– $ 2,500	(–2.50% of $100,000)

In the absence of transaction costs, Ellen's loss is equal to Kelly's gain. If the Treasury bond futures price had remained below the exercise price of 94-32 ($94,500) until the expiration date, the option would not have been exercised. In that case, the net gain from purchasing the call option on Treasury bond futures would have been –$2,000 (the premium paid for the option) and the net gain from selling the call option would have been $2,000. ●

When interest rates decline, the buyers of call options on Treasury bonds may simply sell their previously purchased options just before expiration. If interest rates rise, the options will not be desirable. Then buyers of call options on Treasury bond futures will let their options expire, and their loss will be the premium paid for the call options on futures. Thus the loss from purchasing options on futures is more limited than the loss from simply purchasing futures contracts.

Some speculators who expect interest rates to remain stable or decline may be willing to sell a put option on Treasury bond futures. If their expectations are correct, the price of a futures contract will likely rise and so the put option will not be exercised. Therefore, sellers of the put option would earn the premium that was paid to them when they sold the option.

Speculation Based on an Expected Increase in Interest Rates If speculators expect interest rates to increase, they can benefit from purchasing a put option on Treasury bond futures. If their expectations are correct, the market value of Treasury bonds will decline and so the price of a Treasury bond futures contract will also decline. The speculators can exercise their option to sell futures at the exercise price, which will be higher than the value of the futures contract. They can then purchase futures (to create an offsetting position) at a lower price than the price at which they sold futures. If interest rates decline, the speculators will likely let the options expire and their loss will be the premium paid for the put options on futures.

EXAMPLE John Drummer expects interest rates to increase and purchases a put option on Treasury bond futures. Assume the exercise price on Treasury bond futures is 97-00 ($97,000) and the premium

paid for the put option is 3-00 ($3,000). Assume that interest rates do increase and, as a result, the price of the Treasury bond futures contract declines over time to a value of 89-00 ($89,000) shortly before the option's expiration date. At this time, John decides to exercise the option and closes out the position by purchasing an identical futures contract. John's net gain from this speculative strategy is

Selling price of T-bond futures	$97,000	(97.00% of $100,000)
− Purchase price of T-bond futures	− $89,000	(89.00% of $100,000)
− Put option premium received	− $ 3,000	(3.00% of $100,000)
= Net gain to purchaser of put option of futures	$ 5,000	(5.00% of $100,000)

The net gain of $5,000 represents a return on investment of about 167 percent. ●

The person who sold the put option on Treasury bond futures to John in this example incurred a loss of $5,000, assuming that the position was closed out (by selling an identical futures contract) on the same date that John's position was closed out. If the Treasury bond futures price had remained above the exercise price of 97–00 until the expiration date, then the option would not have been exercised and John would have lost $3,000 (the premium paid for the put option).

Some speculators who anticipate an increase in interest rates may be willing to sell a call option on Treasury bond futures. If their expectations are correct, the price of the futures contract will likely decline and hence the call option will not be exercised.

14-6b Hedging with Options on Interest Rate Futures

Options on futures contracts are also used to hedge against risk. Financial institutions commonly hedge their bond or mortgage portfolios with options on interest rate futures contracts. The position they take on the options contract is designed to create a gain that can offset a loss on their bond or mortgage portfolio while still allowing some upside potential.

EXAMPLE

Emory Savings and Loan Association has a large number of long-term, fixed-rate mortgages that are mainly supported by short-term funds and would therefore be adversely affected by rising interest rates. As shown in the previous chapter, sales of Treasury bond futures can partially offset the adverse effect of rising interest rates in such a situation. Recall that if interest rates decline instead, the potential increase in Emory's interest rate spread (difference between interest revenues and expenses) would be partially offset by the loss on the futures contract.

One potential limitation of selling interest rate futures to hedge mortgages is that households may prepay their mortgages. If interest rates decline and most fixed-rate mortgages are prepaid, Emory will incur a loss on the futures position without an offsetting gain on its spread. To protect against this risk, Emory can purchase put options on Treasury bond futures. Suppose that Emory purchases put options on Treasury bond futures with an exercise price of 98-00 ($98,000) for a premium of 2-00 ($2,000) per contract. The initial Treasury bond futures price is 99-00 at the time. First, assume that interest rates rise, causing a decline in the Treasury bond futures price to 91-00. In this scenario, Emory will exercise its right to sell Treasury bond futures and offset its position by purchasing identical futures contracts and thereby generate a net gain of $5,000 per contract, as shown in Exhibit 14.15. The gain on the futures position helps to offset the reduction in Emory's spread that occurs because of the higher interest rates.

Now consider a second scenario in which interest rates decline, causing the Treasury bond futures price to rise to 104-00. In this scenario, Emory does not exercise the put options on Treasury bond futures because the futures position would result in a loss. ●

This example shows how a put option on futures offers more flexibility than simply selling futures. However, a premium must be paid for the put option. Financial institutions

Exhibit 14.15 Results from Hedging with Put Options on Treasury Bond Futures

	SCENARIO 1: • INTEREST RATES RISE • T-BOND FUTURES PRICE DECLINES TO 91–00	SCENARIO 2: • INTEREST RATES DECLINE • T-BOND FUTURES PRICE INCREASES TO 104–00
Effect on Emory's spread	Spread is reduced.	Spread is increased, but mortgage prepayments may occur.
Effect on T-bond futures price	Futures price decreases.	Futures price increases.
Decision on exercising the put option	Exercise put option.	Do not exercise put option.
Selling price of T-bond futures	$98,000	Not sold
– Purchase price of T-bond futures	– $91,000	Not purchased
– Price paid for put option	– $2,000	– $2,000
= Net gain per option	$5,000	– $2,000

that wish to hedge against rising interest rate risk should compare the possible outcomes from selling interest rate futures contracts versus purchasing put options on interest rate futures in order to hedge interest rate risk.

14-6c Hedging with Options on Stock Index Futures

Financial institutions and other investors commonly hedge their stock portfolios with options on stock index futures contracts. The position they take on the options contract is designed to create a gain that can offset a loss on their stock portfolio while still allowing some upside potential.

EXAMPLE

You currently manage a stock portfolio that is valued at $400,000, and you plan to hold these stocks over a long-term period. However, you are concerned that the stock market may experience a temporary decline over the next three months and that your stock portfolio will probably decline by about the same degree as the market. You want to create a hedge so that your portfolio will decline no more than 3 percent from its present value, but you would like to maintain any upside potential. You can purchase a put option on index futures to hedge your stock portfolio. Put options on S&P 500 index futures are available with an expiration date about three months from now.

Assume that the S&P 500 index level is currently 1600 and that one particular put option on index futures has a strike price of 1552 (3 percent less than the prevailing index level) and a premium of 10. Since the options on S&P 500 index futures are priced at $250 times the quoted premium, the dollar amount to be paid for this option is 10 × $250 = $2,500. If the index level declines below 1552 (reflecting a decline of more than 3 percent), then you may exercise the put option on index futures, which gives you the right to sell the index for a price of 1552. At the settlement date of the futures contract, you will receive $250 times the difference between the futures price of 1552 and the prevailing index level. If the market declines by 5 percent, for example, the index will decline from 1600 to 1520. There will be a gain on the index futures contract of (1552 – 1520) × $250 = $8,000. Meanwhile, a 5 percent decline in the value of the portfolio reflects a loss of $20,000 (0.05 × $400,000 = $20,000). The $8,000 gain (excluding the premium paid) from the options contract reduces the overall loss to $12,000, or 3 percent of the portfolio. ●

Determining the Degree of the Hedge with Options on Stock Index Futures In the previous example, losses of less than 3 percent are not hedged. When using put options to hedge, various strike prices exist for an option on a specific stock

index and for a specific expiration date. For example, put options on the S&P 500 index may be available with strike prices of 1760, 1800, 1840, and so on. The higher the strike price relative to the prevailing index value, the higher the price at which the investor can lock in the sale of the index. However, a higher premium must be paid to purchase put options with a higher strike price. From a hedging perspective, this simply illustrates that a higher price must be paid to "insure" (hedge) against losses resulting from stock market downturns. This concept is analogous to automobile insurance, where a person must pay a higher premium for a policy that features a lower deductible.

Selling Call Options to Cover the Cost of Put Options In the previous example, the cost of hedging with a put option on index futures is $2,500. Given your expectations of a weak stock market over the next three months, you could generate some fees by selling call options on S&P 500 index futures to help cover the cost of purchasing put options.

EXAMPLE

Assume that there is a call option on S&P 500 index futures with a strike price of 1648 (3 percent above the existing index level) and a premium of 10. You can sell a call option on index futures for $2,500 (10 × $250) and use the proceeds to pay the premium on the put option. The obvious disadvantage of selling a call option to finance the purchase of the put option is that it limits your upside potential. For example, if the market rises by 5 percent over the three-month period, the S&P 500 index level will rise to 1680. The difference between this level and the strike price of 1648 on the call option forces you to make a payment of (1680 − 1648) × $250 = $8,000 to the owner of the call option. This partially offsets the gain to your portfolio that resulted from the favorable market conditions. ●

When attempting to hedge larger portfolios than the one in the previous example, additional put options would be purchased to hedge the entire portfolio against a possible decline in the market. For example, if your stock portfolio were $1.2 million, you would need to purchase three put options on S&P 500 index futures contracts. Since each index futures contract would have a value of $400,000, you would need a short position in three index futures contracts to hedge the entire stock portfolio (assuming that the index and the stock portfolio move in tandem).

14-7 Options as Executive Compensation

Many firms distribute stock options to executives and other managers as a reward for good performance. For example, a manager may receive a salary along with call options on 10,000 shares of stock that have an exercise price above the prevailing price and an expiration date of five years from today. The purpose of awarding options as compensation is to increase the executive's incentive to make decisions that increase the value of the firm's stock, as their compensation from options is tied to the stock price.

14-7a Limitations of Option Compensation

Many option compensation programs do not account for general market conditions. Thus executives who owned stock options when general stock market conditions were more favorable may have earned high compensation because their firms' stock prices increased substantially during that period, even for firms that performed poorly relative to others in the same industry. Because compensation from holding options is driven more by general stock market conditions than by the firm's relative performance, stock options are not always effective at aligning executives' incentives with actual firm performance.

Another concern with using options as compensation is that executives with substantial options may be tempted to manipulate the stock's price upward in the short term, even

though doing so adversely affects the stock price in the long term. For example, they might use accounting methods that defer the reporting of some expenses until next year and accelerate the reporting of some revenue. In this way, short-term earnings will appear favorable but earnings in the following period will be reduced. When these executives believe that the stock price has peaked in the short term, they can exercise their options by selling their shares in the secondary market. Firms can prevent the wrongful use of options by requiring that executives hold them for several years before exercising them.

Until 2006, firms did not have to report their options as an expense but could claim them as a tax deduction. If Enron Corporation had reported its option compensation as expenses on its income statements over the five-year period preceding its 2001 bankruptcy, its net income would have been reduced by $600 million. Because options did not have to be reported as an expense on the income statements, some firms were overly generous in awarding options. Global Crossing's CEO earned $730 million from options before the firm filed for bankruptcy. Largely as a result of options, U.S. CEO compensation is more than 500 times the average compensation of a firm's employees.

Backdating Options In the late 1990s and early 2000s, some firms allowed their CEOs to backdate options they had already been granted to an earlier period when the stock price was lower. This enabled the CEOs to use a lower exercise price on their call options, generating larger gains for them when they exercised their options. Thus option compensation to some CEOs was mostly influenced by the backdating process and not by how well the stock performed. When the practice of backdating options was publicized in 2006, firms that allowed backdating terminated the practice.

14-8 Globalization of Options Markets



The globalization of stock markets has resulted in the need for a globalized market in stock options. Options on stock indexes representing various countries are now available. Options exchanges have been established in numerous countries, including Australia, Austria, Belgium, France, Germany, and Singapore. U.S. portfolio managers who maintain large holdings of stocks from specific countries are heavily exposed to the conditions of those markets. Rather than liquidate the portfolio of foreign stocks to protect against a possible temporary decline, the managers can purchase put options on the foreign stock index of concern. Portfolio managers residing in these countries can also use this strategy to hedge their stock portfolios.

Portfolio managers desiring to capitalize on the expectation of temporary favorable movements in foreign markets can purchase call options on the corresponding stock indexes. Thus the existence of options on foreign stock indexes allows portfolio managers to hedge or speculate based on forecasts of foreign market conditions. The trading of options on foreign stock indexes avoids the transaction costs associated with buying and selling large portfolios of foreign stocks.

14-8a Currency Options Contracts

A **currency call option** provides the right to purchase a specified currency for a specified price within a specified period of time. Corporations involved in international business transactions use currency call options to hedge future payables. If the exchange rate at the time payables are due exceeds the exercise price, corporations can exercise their options and purchase the currency at the exercise price. If the prevailing exchange rate is lower than the exercise price, corporations can purchase the currency at the prevailing exchange rate and let the options expire.

Speculators purchase call options on currencies that they expect to strengthen against the dollar. If the foreign currency strengthens as expected, they can exercise their call options to purchase the currency at the exercise price and then sell the currency at the prevailing exchange rate.

A **currency put option** provides the right to sell a specified currency for a specified price within a specified period of time. Corporations involved in international business transactions may purchase put options to hedge future receivables. If the exchange rate at the time they receive payment in a foreign currency is less than the strike price, they can exercise their option by selling the currency at that price. But if the prevailing exchange rate is higher than the exercise price, they can sell the currency at the prevailing exchange rate and let the options expire.

Speculators purchase put options on currencies they expect to weaken against the dollar. If the foreign currency weakens as expected, the speculators can purchase the currency at the prevailing spot rate and exercise their put options to sell the currency at the exercise price.

For every buyer of a currency call or put option, there must be a seller (or writer). A writer of a call option is obligated to sell the specified currency at the specified strike price if the option is exercised. A writer of a put option is obligated to purchase the specified currency at the specified strike price if the option is exercised. Speculators are inclined to write call options on foreign currencies that they expect to weaken against the dollar or to write put options on those they expect to strengthen against the dollar. If a currency option expires without being exercised, the writer earns the up-front premium received.

Summary

- Stock options are traded on exchanges, just as many stocks are. Orders submitted by a brokerage firm are transmitted to a trading floor, where floor brokers execute the trades. Many trades are executed electronically.
- The premium of a call option is influenced by the characteristics of the option and of the underlying stock that can affect the potential gains. In particular, the premium is higher when the market price of the stock is high relative to the exercise price, when the stock's volatility is greater, and when the term until expiration is longer. For put options, the higher the market price of the stock relative to the exercise price, the lower the premium. The volatility of the underlying stock and the term to expiration are related to the put option premium in the same manner as they are to the call option premium.
- Speculators purchase call options on stocks whose prices are expected to rise and purchase put options on those expected to decrease.
- Financial institutions can hedge against adverse movements in a stock by selling call options on that stock. Alternatively, they can purchase put options on that stock.
- Financial institutions commonly hedge their stock portfolios by purchasing put options on stock indexes. They may also use stock index options as a tool for dynamic asset allocation, increasing their exposure when they have optimistic views about the stock market and reducing their exposure (buying put options on stock indexes) when they have pessimistic views.
- Speculators purchase call options on interest rate futures contracts when they expect interest rates to decrease. Financial institutions with large holdings of long-term debt securities hedge against interest rate risk by purchasing put options on interest rate futures. Index options can be used to speculate on movements in stock indexes and require only a small investment. Put options on stock indexes can be purchased to hedge a stock portfolio whose movements are similar to that of the stock index. Options on stock index futures can be used to speculate on movements in the value of the stock index futures contract. Put options on stock index futures can be purchased to hedge portfolios of stocks that move in tandem with the stock index.

POINT COUNTER-POINT

If You Were a Major Shareholder of a Publicly Traded Firm, Would You Prefer That Stock Options Be Traded on That Stock?

Point No. Options can be used by investors to speculate, and excessive trading of the options may push the stock price away from its fundamental price.

Counter-Point Yes. Options can be used by investors to temporarily hedge against adverse movements in the stock, so they may reduce the selling pressure on the stock in some periods.

Who Is Correct? Use the Internet to learn more about this issue and then formulate your own opinion.

QUESTIONS AND APPLICATIONS

1. Options versus Futures Describe the general differences between a call option and a futures contract.

2. Speculating with Call Options How are call options used by speculators? Describe the conditions under which their strategy would backfire. What is the maximum loss that could occur for a purchaser of a call option?

3. Speculating with Put Options How are put options used by speculators? Describe the conditions under which their strategy would backfire. What is the maximum loss that could occur for a purchaser of a put option?

4. Selling Options Under what conditions would speculators sell a call option? What is the risk to speculators who sell put options?

5. Factors Affecting Call Option Premiums Identify the factors affecting the premium paid on a call option. Describe how each factor affects the size of the premium.

6. Factors Affecting Put Option Premiums Identify the factors affecting the premium paid on a put option. Describe how each factor affects the size of the premium.

7. Leverage of Options How can financial institutions with stock portfolios use stock options when they expect stock prices to rise substantially but do not yet have sufficient funds to purchase more stock?

8. Hedging with Put Options Why would a financial institution holding the stock of Hinton Co. consider buying a put option on that stock rather than simply selling it?

9. Call Options on Futures Describe a call option on interest rate futures. How does it differ from purchasing a futures contract?

10. Put Options on Futures Describe a put option on interest rate futures. How does it differ from selling a futures contract?

Advanced Questions

11. Hedging Interest Rate Risk Assume a savings institution has a large amount of fixed-rate mortgages and obtains most of its funds from short-term deposits. How could it use options on financial futures to hedge its exposure to interest rate movements? Would futures or options on futures be more appropriate if the institution is concerned that interest rates will decline, causing a large number of mortgage prepayments?

12. Hedging Effectiveness Three savings and loan institutions (S&Ls) have identical balance sheet compositions: a high concentration of short-term deposits that are used to provide long-term, fixed-rate mortgages. The S&Ls took the following positions one year ago.

NAME OF S&L	POSITION
LaCrosse	Sold financial futures
Stevens Point	Purchased put options on interest rate futures
Whitewater	Did not take any position in futures

Assume that interest rates declined consistently over the last year. Which of the three S&Ls would have achieved the best performance based on this information? Explain.

13. Change in Stock Option Premiums Explain how and why the option premiums may change in response to a surprise announcement that the Fed will increase interest rates, even if stock prices are not affected.

14. Speculating with Stock Options The price of Garner stock is $40. There is a call option on Garner stock that is at the money with a premium of $2.00. There is a put option on Garner stock that is at the money with a premium of $1.80. Why would investors consider writing this call option and this put option? Why would some investors consider buying this call option and this put option?

15. How Stock Index Option Prices May Respond to Prevailing Conditions Consider the prevailing conditions that could affect the demand for stocks, including inflation, the economy, the budget deficit, the Fed's monetary policy, political conditions, and the general mood of investors. Based on these conditions, would you consider purchasing stock index options at this time? Offer some logic to support your answer. Which factor do you think will have the biggest impact on stock index option prices?

16. Backdating Stock Options Explain what backdating stock options entails. Is backdating consistent with rewarding executives who help to maximize shareholder wealth?

17. CBOE Volatility Index How would you interpret a large increase in the CBOE volatility index (VIX)? Explain why the VIX increased substantially during the credit crisis.

Interpreting Financial News

Interpret the following comments made by Wall Street analysts and portfolio managers.

a. "Our firm took a hit because we wrote put options on stocks just before the stock market crash."

b. "Before hedging our stock portfolio with options on index futures, we search for the index that is most appropriate."

c. "We prefer to use covered call writing to hedge our stock portfolios."

Managing in Financial Markets

Hedging with Stock Options As a stock portfolio manager, you have investments in many U.S. stocks and plan to hold these stocks over a long-term period. However, you are concerned that the stock market may experience a temporary decline over the next three months and that your stock portfolio will probably decline by about the same degree as the market. You are aware that options on S&P 500 index futures are available. The following options on S&P 500 index futures are available and have an expiration date about three months from now:

STRIKE PRICE	CALL PREMIUM	PUT PREMIUM
1372	40	24
1428	24	40

The options on S&P 500 index futures are priced at $250 times the quoted premium. Currently, the S&P 500 index level is 1400. The strike price of 1372 represents a 2 percent decline from the prevailing index level, and the strike price of 1428 represents an increase of 2 percent above the prevailing index level.

a. Assume that you want to take an options position to hedge your entire portfolio, which is currently valued at about $700,000. How many index option contracts should you take a position in to hedge your entire portfolio?

b. Assume that you want to create a hedge so that your portfolio will lose no more than 2 percent from its present value. How can you take a position in options on index futures to achieve this goal? What is the cost to you as a result of creating this hedge?

c. Given your expectations of a weak stock market over the next three months, how can you generate some fees from the sale of options on S&P 500 index futures to help cover the cost of purchasing options?

PROBLEMS

1. Writing Call Options A call option on Illinois stock specifies an exercise price of $38. Today, the stock's price is $40. The premium on the call option is $5. Assume the option will not be exercised until maturity, if at all. Complete the following table:

ASSUMED STOCK PRICE AT THE TIME THE CALL OPTION IS ABOUT TO EXPIRE	NET PROFIT OR LOSS PER SHARE TO BE EARNED BY THE WRITER (SELLER) OF THE CALL OPTION
$37	
39	
41	
43	
45	
48	

2. Purchasing Call Options A call option on Michigan stock specifies an exercise price of $55. Today, the stock's price is $54 per share. The premium on the call option is $3. Assume the option will not be exercised until maturity, if at all. Complete the following table for a speculator who purchases the call option:

ASSUMED STOCK PRICE AT THE TIME THE CALL OPTION IS ABOUT TO EXPIRE	NET PROFIT OR LOSS PER SHARE TO BE EARNED BY THE SPECULATOR
$50	
52	
54	
56	
58	
60	
62	

3. Purchasing Put Options A put option on Iowa stock specifies an exercise price of $71. Today, the stock's price is $68. The premium on the put option is $8. Assume the option will not be exercised until maturity, if at all. Complete the following table for a speculator who purchases the put option (and currently does not own the stock):

ASSUMED STOCK PRICE AT THE TIME THE PUT OPTION IS ABOUT TO EXPIRE	NET PROFIT OR LOSS PER SHARE TO BE EARNED BY THE SPECULATOR
$60	
64	
68	
70	
72	
74	
76	

4. Writing Put Options A put option on Indiana stock specifies an exercise price of $23. Today, the stock's price is $24. The premium on the put option is $3. Assume the option will not be exercised until maturity, if at all. Complete the following table:

ASSUMED STOCK PRICE AT THE TIME THE PUT OPTION IS ABOUT TO EXPIRE	NET PROFIT OR LOSS PER SHARE TO BE EARNED BY THE WRITER (OR SELLER) OF THE PUT OPTION
$20	
21	
22	
23	
24	
25	
26	

5. Covered Call Strategy

a. Evanston Insurance, Inc., has purchased shares of Stock E at $50 per share. It will sell the stock in six months. It considers using a strategy of covered call

writing to partially hedge its position in this stock. The exercise price is $53, the expiration date is six months, and the premium on the call option is $2. Complete the following table:

[illegible]		
$47		
50		
52		
55		
57		
60		

b. Assume that each of the six stock prices in the table's first column has an equal probability of occurring. Compare the probability distribution of the profits (or losses) per share when using covered call writing versus not using it. Would you recommend covered call writing in this situation? Explain.

6. Put Options on Futures Purdue Savings and Loan Association purchased a put option on Treasury bond futures with a September delivery date and an exercise price of 91–16. The put option has a premium of 1–32. Assume that the price of the Treasury bond futures decreases to 88–16. Should Purdue exercise the option or let it expire? What is Purdue's net gain or loss after accounting for the premium paid on the option?

7. Call Options on Futures Wisconsin, Inc., purchased a call option on Treasury bond futures at a premium of 2–00. The exercise price is 92–08. If the price of the Treasury bond futures rises to 93–08, should Wisconsin exercise the call option or let it expire? What is Wisconsin's net gain or loss after accounting for the premium paid on the option?

8. Call Options on Futures DePaul Insurance Company purchased a call option on an S&P 500 futures contract. The option premium is quoted as $6. The exercise price is 1430. Assume the index on the futures contract becomes 1440. Should DePaul exercise the call option or let it expire? What is the net gain or loss to DePaul after accounting for the premium paid for the option?

9. Covered Call Strategy Coral, Inc., has purchased shares of Stock M at $28 per share. Coral will sell the stock in six months. It considers using a strategy of covered call writing to partially hedge its position in this stock. The exercise price is $32, the expiration date is six months, and the premium on the call option is $2.50. Complete the following table:

[illegible]	[illegible]
$25	
28	
33	
36	

10. Hedging with Bond Futures Smart Savings Bank desired to hedge its interest rate risk. It considered two possibilities: (1) sell Treasury bond futures at a price of 94- 00, or (2) purchase a put option on Treasury bond futures. At the time, the price of Treasury bond futures was 95–00. The face value of Treasury bond futures was $100,000. The put option premium was 2–00, and the exercise price was 94–00. Just before the option expired, the Treasury bond futures price was 91–00, and Smart Savings Bank would have exercised the put option at that time, if at all. This is also the time when it would have offset its futures position, if it had sold futures. Determine the net gain to Smart Savings Bank if it had sold Treasury bond futures versus if it had purchased a put option on Treasury bond futures. Which alternative would have been more favorable, based on the situation that occurred?

FLOW OF FUNDS EXERCISE

Hedging with Options Contracts

Carson Company would like to acquire Vinnet, Inc., a publicly traded firm in the same industry. Vinnet's stock price is currently much lower than the prices of other firms in the industry because it is inefficiently managed. Carson believes that it could restructure Vinnet's operations and improve its performance. It is about to contact Vinnet to determine whether Vinnet will agree to an acquisition. Carson is somewhat concerned that investors may learn of its plans and buy Vinnet stock in anticipation that Carson will need to pay a high premium (perhaps a 30 percent premium above the prevailing stock price) in order to complete the acquisition. Carson decides to call a bank about its risk, as the bank has a brokerage subsidiary that can help it hedge with stock options.

a. How can Carson use stock options to reduce its exposure to this risk? Are there any limitations to this strategy, given that Carson will ultimately have to buy most or all of the Vinnet stock?

b. Describe the maximum possible loss that may be directly incurred by Carson as a result of engaging in this strategy.

c. Explain the results of the strategy you offered in the previous question if Vinnet plans to avoid the acquisition attempt by Carson.

INTERNET/EXCEL EXERCISES

1. Go to www.cboe.com and, under "Quotes & Data," select "Delayed Quotes Classic." Insert the ticker symbol for a stock option in which you are interested. Assess the results. Did the premium ("Net") on the call options increase or decrease today? Did the premium on the put options increase or decrease today?

2. Based on the changes in the premium, do you think the underlying stock price increased or decreased? Explain.

ONLINE ARTICLES WITH REAL-WORLD EXAMPLES

Find a recent practical article available online that describes a real-world example regarding a specific financial institution or financial market that reinforces one or more concepts covered in this chapter.

If your class has an online component, your professor may ask you to post your summary of the article there and provide a link to the article so that other students can access it. If your class is live, your professor may ask you to summarize your application of the article in class. Your professor may assign specific students to complete this assignment or may allow any students to do the assignment on a volunteer basis.

For recent online articles and real-world examples related to this chapter, consider using the following search terms (be sure to include the prevailing year as a search term to ensure that the online articles are recent):

1. stock options AND profits
2. stock options AND losses
3. stock options AND speculators
4. stock options AND hedge
5. stock option premium AND volatility
6. stock option AND ETFs
7. stock index option
8. LEAPs AND speculate
9. selling stock options AND cover
10. stock options AND compensation

APPENDIX 14

Option Valuation

The Binomial Pricing Model

The binomial option-pricing model was originally developed by William F. Sharpe. An advantage of the model is that it can be used to price both European-style and American-style options with or without dividends. European options are put or call options that can be exercised only at maturity; American options can be exercised at any time prior to maturity.

Assumptions of the Binomial Pricing Model

The following are the main assumptions of the binomial pricing model:

1. The continuous random walk underlying the Black-Scholes model can be modeled by a discrete random walk with the following properties:
   - The asset price changes only at discrete (noninfinitesimal) time steps.
   - At each time step, the asset price may move either up or down; thus there are only two returns, and these two returns are the same for all time steps.
   - The probabilities of moving up and down are known.
2. The world is risk-neutral. This allows the assumption that investors' risk preferences are irrelevant and that investors are risk-neutral. Furthermore, the return from the underlying asset is the risk-free interest rate.

Using the Binomial Pricing Model to Price Call Options

The following is an example of how the binomial pricing model can be employed to price a call option (i.e., to determine a call option premium). To use the model, we need information for three securities: the underlying stock, a risk-free security, and the stock option.

Assume that the price of Gem Corporation stock today is $100. Furthermore, it is estimated that Gem stock will be selling for either $150 or $70 in one year. That is, the stock is expected either to rise by 50 percent or to fall by 30 percent. Also assume that the annual risk-free interest rate on a one-year Treasury bill is 10 percent, compounded continuously. Assume that a T-bill currently sells for $100. Since interest is continuously compounded, the T-bill will pay interest of $\$100 \times (e^{10} - 1)$, or $10.52.

Currently, a call option on Gem stock is available with an exercise price of $100 and an expiration date one year from now. Since the call option is an option to buy Gem stock, the option will have a value of $50 if the stock price is $150 in one year. If the stock price in one year is $70, the call option will have a value of $0. Our objective is to value this call option using the binomial pricing model.

The first step in applying the model to this call option is to recognize that three investments are involved: the stock, a risk-free security, and the call option. Using the information already given, we have the following payoff matrix in one year:

SECURITY	PRICE IF STOCK IS WORTH $150 IN ONE YEAR	PRICE IF STOCK IS WORTH $70 IN ONE YEAR	CURRENT PRICE
Gem stock	$150.00	$70.00	$100.00
Treasury bill	110.52	110.52	100.00
Call option	50.00	0.00	?

The objective of the binomial pricing model is to determine the current price of the call option. The key to understanding the valuation of the call option using the binomial pricing model is that the option's value must be based on a combination of the value of the stock and the T-bill. If this were not the case, arbitrage opportunities would result. Consequently, in either the up or the down state, the payoff of a portfolio consisting of N_s shares of Gem stock and N_b T-bills must be equal to the value of the call option in that state. Using the payoff matrix just given, we derive the following system of two equations:

$$150N_s + 110.52N_b = 50$$
$$70N_s + 110.52N_b = 0$$

Since we are dealing with two linear equations with two unknowns, we can easily solve for the two variables by substitution. Doing so gives the following values for the number of shares and the number of T-bills in the investor's so-called replicating portfolio:

$$N_s = 0.625$$
$$N_b = -0.3959$$

In other words, the payoffs of the call option on Gem stock can be replicated by borrowing $39.59 at the risk-free rate and buying 0.625 shares of Gem stock for $62.50 (since one share currently sells for $100). Since the payoff of this replicating portfolio is the same as that for the call, the cost to the investor must be the value of the call. In this case, since $39.59 of the outlay of $62.50 is financed by borrowing, the outlay to the investor is $62.50 − $39.59 = $22.91. Thus the call option premium must be $22.91.

In equation form, the value of the call option (V_c) can therefore be written as

$$V_c = N_s P_s + N_b P_b$$

Computation of the N_s can be simplified somewhat. More specifically,

$$N_s = h = \frac{P_{ou} - P_{od}}{P_{su} - P_{sd}}$$

where

P_{ou} = value of the option in the up state
P_{od} = value of the option in the down state
P_{su} = price of Gem stock in the up state
P_{sd} = price of Gem stock in the down state

This is also referred to as the *hedge ratio (h)*.

In this example, the amount borrowed (BOR) is equal to the product of the number of risk-free securities in the replicating portfolio and the price of the risk-free security:

$$N_b P_b = \text{BOR} = PV(hP_{sd} - P_{od})$$

where

PV = present value of a continuously compounded sum
h = hedge ratio

Thus the value of the call option can be expressed more simply as

$$V_c = hP_s + \text{BOR}$$

To illustrate why the relationships discussed so far should hold, we assume for the moment that a call option on Gem stock is selling for a premium of $25 (i.e., the call option is overpriced). In this case, investors are presented with an arbitrage opportunity to make an instantaneous, riskless profit. In particular, investors could write a call, buy the stock, and borrow at the risk-free rate. Now assume that the call option on Gem stock is selling for a premium of only $20 (i.e., the call option is underpriced). Using arbitrage, investors would buy a call, sell the stock short, and invest at the risk-free rate.

Using the Binomial Pricing Model to Price Put Options

Continuing with the example of Gem Corporation, the only item that changes in the payoff matrix when the option is a put option (i.e., an option to sell Gem stock) is the value of the option at expiration in the up and down states. If Gem stock is worth $150 in one year, the put option will be worthless; if Gem stock is worth only $70 in one year, the put option will be worth $30. Since the value of the risk-free security is contingent only on the T-bill interest rate, it will be unaffected by the fact that we are now dealing with a put option.

The hedge ratio and the amount borrowed can be easily determined using the formulas introduced previously. The hedge ratio is

$$h = \frac{0 - 30}{150 - 70} = -0.375$$

The amount borrowed is

$$\text{BOR} = PV[-0.375(70) - 30] = \frac{-56.25}{e^{RT}} = -50.90$$

Therefore, to replicate the put option, the investor would sell short 0.375 Gem shares and lend $50.90 at the risk-free rate. Thus the net amount the investor must put up is $50.90 − $37.50 = $13.40. Accordingly, this is the fair value of the put.

Put-Call Parity

With some mathematical manipulation, the following relationship can be derived between the prices of puts and calls (that have the same exercise price and time to expiration):

$$P_p = P_c + \frac{E}{e^{RT}} - P_s$$

where

P_p = price of a put option
P_c = price of a call option
E = exercise price of the option
e^{RT} = present value operator for a continuously compounded sum, discounted at interest rate R for T years
P_s = price of the stock

Using the example of Gem Corporation,

$$P_p = \$22.91 + \frac{\$100}{e^{0.10}} - \$100 = \$13.39$$

The Black-Scholes Option-Pricing Model for Call Options

In 1973, Black and Scholes devised an option-pricing model that motivated further research on option valuation that continues to this day.

Assumptions of the Black-Scholes Option-Pricing Model

The following are some of the key assumptions underlying the Black-Scholes option-pricing model:

1. The risk-free rate is known and constant over the life of the option.
2. The probability distribution of stock prices is lognormal.
3. The variability of a stock's return is constant.
4. The option is to be exercised only at maturity, if at all.
5. There are no transaction costs involved in trading options.
6. Tax rates are similar for all participants who trade options.
7. The stock of concern does not pay cash dividends.

The Black-Scholes Partial Differential Equation

The Black-Scholes option-pricing model was one of the first to introduce the concept *of a riskless hedge.* Assume that an amount π is invested in a risk-free asset. Thus the investor would earn a return of $r\pi dt$ over a time interval dt. If an appropriately selected portfolio—with a current value of π consisting of a company's stock and an offsetting position in an option on that stock—returns more than $r\pi dt$ over a time interval dt, an investor could conduct arbitrage by borrowing at the risk-free rate and investing in the portfolio. Conversely, if the portfolio returns less than $r\pi dt$, the investor would short the portfolio and invest in the risk-free asset. In either case, the arbitrageur would make a

riskless, no-cost, instantaneous profit. Thus the return on the portfolio and on the risk-less asset must be roughly equal.

Using this argument, Black and Scholes developed what has become known as the *Black-Scholes partial differential equation:*

$$\frac{\partial V}{\partial t} + \frac{1}{2}\sigma^2 S^2 \frac{\partial^2 V}{\partial S^2} + rS\frac{\partial V}{\partial S} - rV = 0$$

where

V = value of an option
S = price of the underlying stock
r = risk-free rate of return
t = a measure of time
σ^2 = variance of the underlying stock's price
∂ and ∂^2 = first- and second-order partial derivatives

The Black-Scholes Option-Pricing Model for European Call Options

In order to price an option, the partial differential equation must be solved for V, the value of the option. Assuming that the risk-free interest rate and stock price volatility are constant, solving the Black-Scholes partial differential equation results in the Black-Scholes formula for European call options:

$$V = SN(d_1) - Ee^{-rT}N(d_2)$$

where

V = value of the call option
S = stock price
$N(\cdot)$ = cumulative distribution function for a standardized normal random variable
E = exercise price of the call option
e = base e antilog or 2.7183
r = risk-free rate of return for one year assuming continuous compounding
T = time remaining to maturity of the call option, expressed as a fraction of a year

The terms $N(d_1)$ and $N(d_2)$ deserve further elaboration. The term N represents a cumulative probability for a unit normal variable, where

$$d_1 = \frac{\ln(S/E) + \left(r + \frac{1}{2}\sigma^2\right)(T)}{\sigma\sqrt{T}}$$

and

$$d_2 = \frac{\ln(S/E) + \left(r - \frac{1}{2}\sigma^2\right)(T)}{\sigma\sqrt{T}}$$
$$= d_1 - \sigma\sqrt{T}$$

Here $\ln(S/E)$ is the natural logarithm and σ denotes the standard deviation of the continuously compounded rate of return on the underlying stock.

Using the Black-Scholes Option-Pricing Model to Price a European Call Option

To illustrate how the Black-Scholes equation can be used to price a call option, assume you observe a call option on MPB Corporation stock expiring in six months with an exercise price of \$70. Thus $T = 0.50$ and $E = \$70$. Furthermore, the current price of MPB stock is \$72 and the stock has a standard deviation of 0.10. The annual risk-free rate is 7 percent. Solving for d_1 and d_2, we obtain

$$d_1 = \frac{\ln(72/70) + [0.07 + 0.5(0.10)^2](0.5)}{0.10\sqrt{0.5}} = 0.9287$$

$$d_2 = 0.9287 - 0.10\sqrt{0.50} = 0.8580$$

A table that identifies the area under the standard normal distribution function (see Exhibit 14A.1) can now be used to determine the cumulative probability. Because d_1 is 0.9287, the cumulative probability from zero to 0.9287 is about 0.3235 (from Exhibit 14A.1, using linear interpolation). Because the cumulative probability for a unit normal variable from negative infinity to zero is 0.50, the cumulative probability from negative infinity to 0.9287 is $0.50 + 0.3235 = 0.8235$. For d_2, the cumulative probability from zero to 0.8580 is 0.3045. Therefore, the cumulative probability from negative infinity to 0.8580 is $0.50 + 0.3042 = 0.8042$.

Now that $N(d_1)$ and $N(d_2)$ have been calculated, the call option value can be estimated as follows:

$$V_c = (\$72 \times 0.8235) - \left(\frac{\$70}{e^{0.07 \times 0.50}} \times 0.8045\right) = \$4.91$$

Thus a call option on MPB stock should sell for a premium of \$4.91.

Put-Call Parity

Using the Black-Scholes option-pricing model, the same relationship exists between the price of a call and that of a put as in the binomial option-pricing model. Thus we have

$$P_p = P_c + \frac{E}{e^{RT}} - P_s$$

Deriving the Implied Volatility

In the example of deriving the value of a call option, an estimate of the stock's standard deviation was used. In some cases, investors want to derive the market's implied volatility rather than a valuation of the call option. The volatility is referred to as "implied" under these circumstances because it is not directly observable in the market. The implied volatility can be derived with some software packages by inputting values for the other variables (prevailing stock price, exercise price, option's time to expiration, and interest rate) in the call option-pricing model and also inputting the market premium of the call option. Instead of deriving a value for the call option premium, the prevailing market premium of the call option is used along with these other variables to derive the implied volatility. The software package will also show how the stock's implied volatility is affected for different values of the call option premium. An increase in the market premium of the call option, when other variables have not changed, reflects an increase in the implied volatility. This relationship can be verified by entering a slightly

Exhibit 14A.1 Institutional Use of Options Markets

d	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.0000	0.0040	0.0080	0.0120	0.0160	0.0199	0.0239	0.0279	0.0319	0.0359
0.1	0.0398	0.0438	0.0478	0.0517	0.0557	0.0596	0.0636	0.0675	0.0714	0.0753
0.2	0.0793	0.0832	0.0871	0.0910	0.0948	0.0987	0.1026	0.1064	0.1103	0.1141
0.3	0.1179	0.1217	0.1255	0.1293	0.1331	0.1368	0.1406	0.1443	0.1480	0.1517
0.4	0.1554	0.1591	0.1628	0.1664	0.1700	0.1736	0.1772	0.1808	0.1844	0.1879
0.5	0.1915	0.1950	0.1985	0.2019	0.2054	0.2088	0.2123	0.2157	0.2190	0.2224
0.6	0.2257	0.2291	0.2324	0.2357	0.2389	0.2422	0.2454	0.2486	0.2517	0.2549
0.7	0.2580	0.2611	0.2642	0.2673	0.2704	0.2734	0.2764	0.2794	0.2823	0.2852
0.8	0.2881	0.2910	0.2939	0.2967	0.2995	0.3023	0.3051	0.3078	0.3106	0.3133
0.9	0.3159	0.3186	0.3213	0.3238	0.3264	0.3289	0.3315	0.3340	0.3365	0.3389
1.0	0.3413	0.3438	0.3461	0.3485	0.3508	0.3531	0.3554	0.3577	0.3599	0.3621
1.1	0.3643	0.3665	0.3686	0.3708	0.3729	0.3749	0.3770	0.3790	0.3810	0.3830
1.2	0.3849	0.3869	0.3888	0.3907	0.3925	0.3944	0.3962	0.3980	0.3997	0.4015
1.3	0.4032	0.4049	0.4066	0.4082	0.4099	0.4115	0.4131	0.4147	0.4162	0.4177
1.4	0.4192	0.4207	0.4222	0.4236	0.4251	0.4265	0.4279	0.4292	0.4306	0.4319
1.5	0.4332	0.4345	0.4357	0.4370	0.4382	0.4394	0.4406	0.4418	0.4429	0.4441
1.6	0.4452	0.4463	0.4474	0.4484	0.4495	0.4505	0.4515	0.4525	0.4535	0.4545
1.7	0.4554	0.4564	0.4573	0.4582	0.4591	0.4599	0.4608	0.4616	0.4625	0.4633
1.8	0.4641	0.4649	0.4656	0.4664	0.4671	0.4678	0.4686	0.4693	0.4699	0.4706
1.9	0.4713	0.4719	0.4726	0.4732	0.4738	0.4744	0.4750	0.4756	0.4761	0.4767
2.0	0.4773	0.4778	0.4783	0.4788	0.4793	0.4798	0.4803	0.4808	0.4812	0.4817
2.1	0.4821	0.4826	0.4830	0.4834	0.4838	0.4842	0.4846	0.4850	0.4854	0.4857
2.2	0.4861	0.4866	0.4868	0.4871	0.4875	0.4878	0.4881	0.4884	0.4887	0.4890
2.3	0.4893	0.4896	0.4898	0.4901	0.4904	0.4906	0.4909	0.4911	0.4913	0.4916
2.4	0.4918	0.4920	0.4922	0.4925	0.4927	0.4929	0.4931	0.4932	0.4934	0.4936
2.5	0.4938	0.4940	0.4941	0.4943	0.4945	0.4946	0.4948	0.4949	0.4951	0.4952
2.6	0.4953	0.4955	0.4956	0.4957	0.4959	0.4960	0.4961	0.4962	0.4963	0.4964
2.7	0.4965	0.4966	0.4967	0.4968	0.4969	0.4970	0.4971	0.4972	0.4973	0.4974
2.8	0.4974	0.4975	0.4976	0.4977	0.4977	0.4978	0.4979	0.4979	0.4980	0.4981
2.9	0.4981	0.4982	0.4982	0.4982	0.4984	0.4984	0.4985	0.4985	0.4986	0.4986
3.0	0.4987	0.4987	0.4987	0.4988	0.4988	0.4989	0.4989	0.4989	0.4990	0.4990

higher market premium into the software program and checking how the implied volatility changes in response to that increase. The point is that investors can detect changes in the implied volatility of a stock by monitoring how the stock's call option premium changes over short intervals of time.

American versus European Options

American Call Options

An American call option is an option to purchase stock that can be exercised at any time prior to maturity. However, the original Black-Scholes model was developed to price European call options, which are options to purchase stock that can be exercised only at maturity. Naturally, European puts could be directly derived using the put–call parity relationship. Consequently, the question is whether the Black-Scholes equation can be used to price American call options.

In general, early exercise of a call may be justified only if the asset makes a cash payment such as a dividend on a stock. If there are no dividends during the life of the option, early exercise would be equivalent to buying something earlier than you need it and then giving up the right to decide later whether you really wanted it. However, if it is possible to save a little money in doing so, early purchase/exercise can sometimes be justified. Early exercise is not appropriate every time there is a dividend, but if early exercise is justified then it should occur just before the stock's ex-dividend date. This minimizes the amount of time value given up without sacrificing the dividend. If there are no dividends on the underlying stock, the Black-Scholes model can be used to price American call options. If the underlying stock pays dividends, however, the Black-Scholes model may not be directly applicable. The binomial option-pricing model can be used to price American call options that pay dividends.

American Put Options

Suppose you purchase a European put option. If the value of the underlying asset goes to zero, then the option has reached its maximum value. It allows you to sell a worthless asset for the exercise price. Yet because the option is European, it cannot be exercised prior to maturity. Its value will simply be the present value of the exercise price, and this value will gradually rise as a function of the time value of money until expiration, when the option will be exercised. This is clearly a situation where you would want an American option, so you could exercise it as soon as the asset value goes to zero.

The previous example indicates that there would be a demand for an option that allowed early exercise. It is not necessary, however, for the asset price to go to zero. The European put price must be at least the present value of the exercise price minus the asset price. Clearly, the present value of the exercise price minus the asset price is less than the exercise price minus the asset price, which is the amount that could be claimed if the put could be exercised early. Thus an American put will sell for more than the European put and so the Black-Scholes option-pricing model cannot be used to price an American put option. There is a point where the right to exercise early is at its maximum value, and at that point the American put would be exercised. Finding that point is difficult, but to do so is to unlock the mystery of pricing the American put.

The only surefire way to price the American put correctly is to use a numerical procedure such as the binomial model. The procedure is similar to partitioning a two-dimensional space of time and the asset price into finer points and then solving either

a difference or a differential equation at each time point. The process starts at expiration and successively works its way back to the present by using the solution at the preceding step. Thus a closed-form solution does not exist. American puts can be viewed as an infinite series of compound options (that is, an option on an option). At each point in time, the holder of the put has the right to decide whether to exercise it or not. A decision not to exercise the put is tantamount to exercising the compound option and obtaining a position in a new compound option, which can be exercised an instant later. The sequence reiterates until the expiration day. This logic can lead to an intuitive but complex mathematical formula that contains an infinite number of terms. Thus, the holders of American puts face an infinite series of early exercise decisions. Only at an instant before the asset goes ex-dividend do the holders know that they should wait to exercise. This is because they know the asset will fall in value an instant later, so they might as well wait an instant and benefit from the decline in value.

15. Swap Markets

CHAPTER OBJECTIVES

The specific objectives of this chapter are to:

- describe the types of interest rate swaps that are available,
- explain the risks of interest rate swaps,
- identify other interest rate derivative instruments that are commonly used,
- explain how credit default swaps are used to reduce credit risk, and
- describe how the swap markets have become globalized.

Many firms have inflow and outflow payments that are not equally sensitive to interest rate patterns. Consequently, they are exposed to interest rate risk. Interest rate swap contracts have been established to reduce these risks. In addition, credit default swap contracts have been established to reduce credit risk.

15-1 BACKGROUND

An **interest rate swap** is an arrangement whereby one party exchanges one set of interest payments for another. In the most common arrangement, fixed-rate interest payments are exchanged for floating-rate interest payments over time. The provisions of an interest rate swap include the following:

- The **notional principal** value to which the interest rates are applied to determine the interest payments involved
- The fixed interest rate
- The formula and type of index used to determine the floating rate
- The frequency of payments, such as every six months or every year
- The lifetime of the swap

For example, a swap arrangement may involve an exchange of 11 percent fixed-rate payments for floating payments at the prevailing one-year Treasury bill rate plus 1 percent, based on $30 million of notional principal, at the end of each of the next seven years. Other money market rates are sometimes used instead of the T-bill rate to index the interest rate.

Although each participant in the swap agreement owes the other participant at each payment date, the amounts owed are typically netted out so that only the net payment is made. If a firm owes 11 percent of $30 million (the notional principal) but is supposed to receive 10 percent of $30 million on a given payment date, it will send a net payment of 1 percent of the $30 million, or $300,000.

The market for swaps is facilitated by over-the-counter trading rather than trading on an organized exchange. Given the uniqueness of the provisions in each swap arrangement, swaps are less standardized than other derivative instruments such as futures or options. Thus, a telecommunications network is more appropriate than an exchange to work out specific provisions of swaps.

Interest rate swaps became more popular in the early 1980s when corporations were experiencing the effects of large fluctuations in interest rates. Although some manufacturing companies were exposed to interest rate movements, financial institutions

were exposed to a greater degree and became the primary users of interest rate swaps. Initially, only those institutions wishing to swap payments on amounts of $10 million or more engaged in interest rate swaps. In recent years, however, swaps have been conducted on smaller amounts as well.

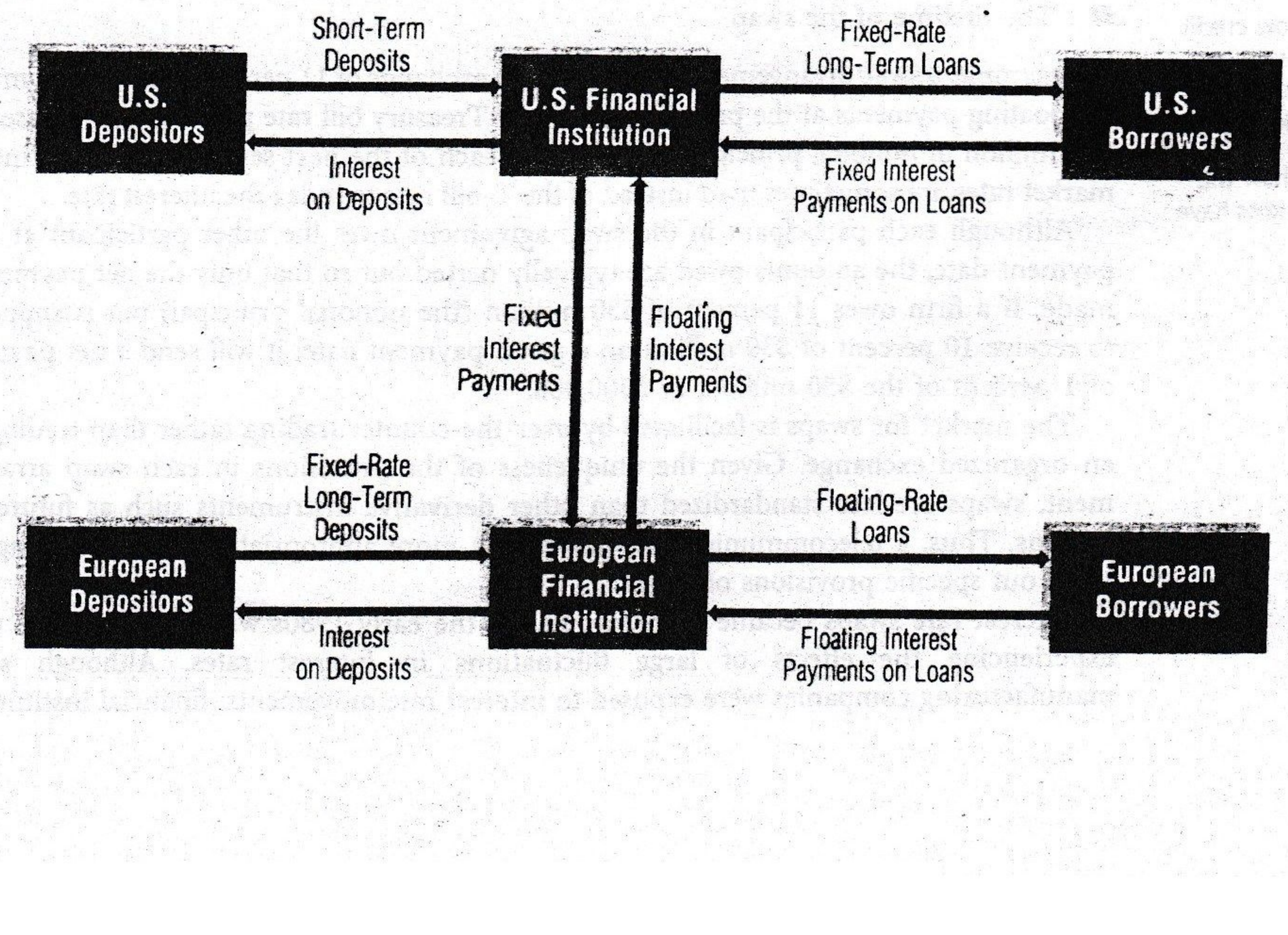
15-1a Use of Swaps for Hedging

Financial institutions such as savings institutions and commercial banks in the United States traditionally had more interest rate–sensitive liabilities than assets and therefore were adversely affected by *increasing* interest rates. Conversely, some financial institutions in other countries (such as some commercial banks in Europe) had access to long-term fixed-rate funding but used funds primarily for floating-rate loans. These institutions were adversely affected by *declining* interest rates.

By engaging in an interest rate swap, both types of financial institutions could reduce their exposure to interest rate risk. Specifically, a U.S. financial institution could send fixed-rate interest payments to a European financial institution in exchange for floating-rate payments. This type of arrangement is illustrated in Exhibit 15.1. In the event of rising interest rates, the U.S. financial institution receives higher interest payments from the floating-rate portion of the swap agreement, which helps to offset the rising cost of obtaining deposits. In the event of declining interest rates, the European financial institution provides lower interest payments in the swap arrangement, which helps to offset the lower interest payments received on its floating-rate loans.

In our example, the U.S. financial institution forgoes the potential benefits from a decline in interest rates while the European financial institution forgoes the potential benefits from an increase in interest rates. The interest rate swap enables each institution to offset any gains or losses that result specifically from interest rate movements. Consequently, as

Exhibit 15.1 Illustration of an Interest Rate Swap



interest rate swaps reduce interest rate risk, they can also reduce potential returns. Most financial institutions that anticipate that interest rates will move in a favorable direction do not hedge their positions. Interest rate swaps are primarily used by financial institutions that would be adversely affected by the expected movement in interest rates.

A primary reason for the popularity of interest rate swaps is the existence of market imperfections. If the parties involved in a swap could easily access funds from various markets without having to pay a premium, they would not need to engage in swaps. Using our previous example, a U.S. financial institution could access long-term funds directly from the European market while the European institution could access short-term funds directly from the U.S. depositors. However, a lack of information about foreign institutions and convenience encourages individual depositors to place deposits locally. Consequently, swaps are necessary for some financial institutions to obtain the maturities or rate sensitivities on funds that they desire.

15-1b Use of Swaps for Speculating

Interest rate swaps are sometimes used by financial institutions and other firms for speculative purposes. For example, a firm may engage in a swap to benefit from its expectations that interest rates will rise even if not all of its operations are exposed to interest rate movements. When the swap is used for speculating rather than for hedging, any loss on the swap positions will not be offset by gains from other operations.

EXAMPLE

Gibson Greetings, Inc., incurred a loss of almost $17 million in 1994 as a result of its positions in interest rate swaps. In the same year, Procter & Gamble incurred a loss of about $157 million as a result of its positions in interest rate swaps. Procter & Gamble then claimed that Bankers Trust (a commercial bank that served as an intermediary and an adviser on interest rate swaps) did not properly advise it about the risk of its swap positions.

Also in 1994, Orange County, California, lost more than $2 billion as a result of its positions in interest rate swaps and other derivative securities. It was positioned to generate large gains if interest rates declined. But instead interest rates increased, and the treasurer of the county took more positions to make up for the resulting losses. He continued to take positions in anticipation that interest rates would decline, but the rates kept on rising throughout 1994. In December 1994, the treasurer resigned and Orange County announced that it would be filing for bankruptcy.

The substantial losses incurred in these cases encouraged firms to more closely monitor the actions of their managers who take derivative positions in order to ensure that those positions are aligned with the firm's goals. ●

15-1c Participation by Financial Institutions

Financial institutions participate in the swap markets in various ways, as summarized in Exhibit 15.2. Financial institutions such as commercial banks, savings institutions, insurance companies, and pension funds that are exposed to interest rate movements commonly engage in swaps to reduce interest rate risk.

A second way to participate in the swap market is by acting as an intermediary. Some commercial banks and securities firms serve in this capacity by matching up firms and facilitating the swap arrangement. Financial institutions that serve as intermediaries for swaps charge fees for their services. They may even provide credit guarantees (for a fee) to each party in the event that the counterparty does not fulfill its obligation. Under these circumstances, the parties engaged in swap agreements assess the creditworthiness of the intermediary that is backing the swap obligations. For this reason, participants in the swap market prefer intermediaries that have a high credit rating.

Exhibit 15.2 Participation of Financial Institutions in Swap Markets

FINANCIAL INSTITUTION	PARTICIPATION IN SWAP MARKETS
Commercial banks	• Engage in swaps to reduce interest rate risk. • Serve as an intermediary by matching up two parties in a swap. • Serve as a dealer by taking the counterparty position to accommodate a party that desires to engage in a swap.
Savings and loan associations and savings banks	• Engage in swaps to reduce interest rate risk.
Finance companies	• Engage in swaps to reduce interest rate risk.
Securities firms	• Serve as an intermediary by matching up two parties in a swap. • Serve as a dealer by taking the counterparty position to accommodate a party that desires to engage in a swap.
Insurance companies	• Engage in swaps to reduce interest rate risk.
Pension funds	• Engage in swaps to reduce interest rate risk.

A third way to participate is by acting as a dealer in swaps. The financial institution takes the counterparty position in order to serve a client. In such a case, the financial institution may be exposing itself to interest rate risk unless it has recently taken the opposite position as a counterparty to another swap agreement.

15-2 Types of Interest Rate Swaps

In response to firms' diverse needs, a variety of interest rate swaps have been created. The following are some of the more commonly used swaps:

- Plain vanilla swaps
- Forward swaps
- Callable swaps
- Putable swaps
- Extendable swaps
- Zero-coupon-for-floating swaps
- Rate-capped swaps
- Equity swaps

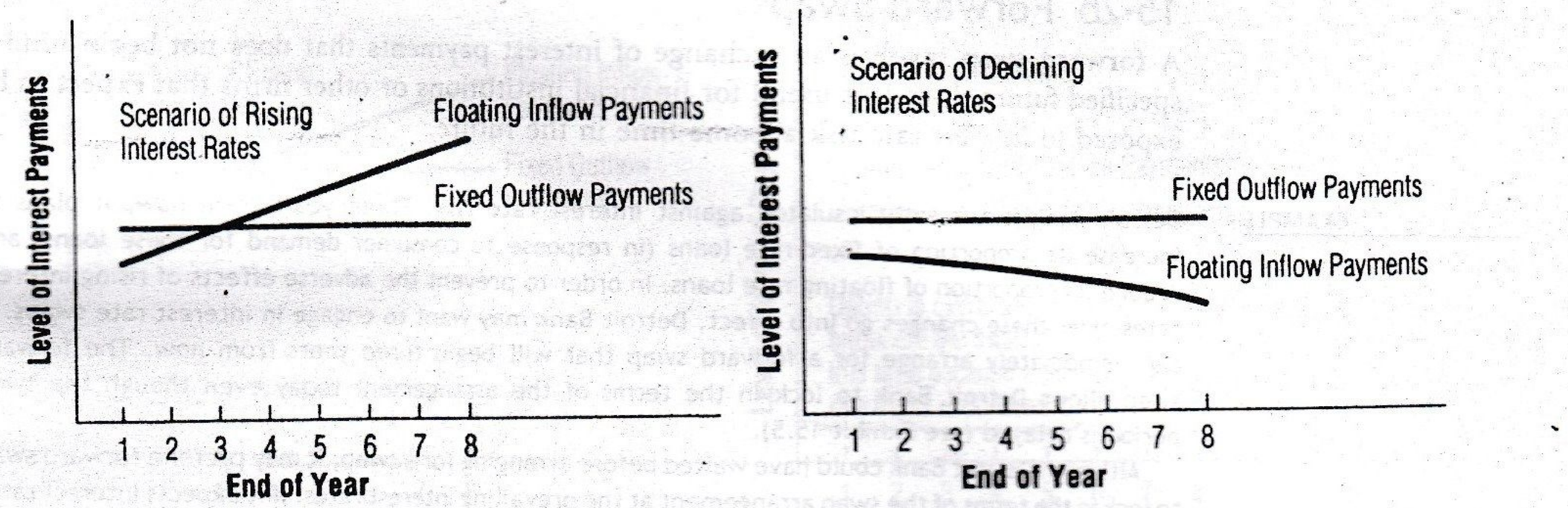
Some types of interest rate swaps are more effective than others at offsetting any unfavorable effects of interest rate movements on the U.S. institution. However, those swaps also offset any favorable effects to a greater degree. Other types of interest rate swaps do not provide as effective a hedge but do allow the institution more flexibility to benefit from favorable interest rate movements.

15-2a Plain Vanilla Swaps

In a **plain vanilla swap**, sometimes referred to as a fixed-for-floating swap, fixed-rate payments are periodically exchanged for floating-rate payments. The earlier example of the U.S. and European institutions involved this type of swap.

Consider the exchange of payments under different interest rate scenarios in Exhibit 15.3 when using a plain vanilla swap. Although infinite possible interest rate scenarios exist, only two scenarios are considered: (1) a consistent rise in market interest rates and (2) a consistent decline in market interest rates.

Exhibit 15.3 Illustration of a Plain Vanilla (Fixed-for-Floating) Swap



EXAMPLE The Bank of Orlando has negotiated a plain vanilla swap in which it will exchange fixed payments of 9 percent for floating payments equal to LIBOR plus 1 percent at the end of each of the next five years. LIBOR is the **London Interbank Offer Rate**, or the interest rate charged on loans between European banks. The LIBOR varies among currencies; for swap examples involving U.S. firms, the LIBOR on U.S. dollars would normally be used. Assume the notional principal is $100 million.

Two scenarios for LIBOR are shown in Exhibit 15.4. The first scenario (in the upper panel of the exhibit) reflects rising U.S. interest rates, which cause LIBOR to increase. The second scenario (in the lower panel) reflects declining U.S. interest rates, which cause LIBOR to decrease. The swap

Exhibit 15.4 Possible Effects of a Plain Vanilla Swap Agreement (Fixed Rate of 9 Percent in Exchange for Floating Rate of LIBOR + 1 Percent)

	YEAR				
SCENARIO I	1	2	3	4	5
LIBOR	7.0%	7.5%	8.5%	9.5%	10.0%
Floating rate received	8.0%	8.5%	9.5%	10.5%	11.0%
Fixed rate paid	9.0%	9.0%	9.0%	9.0%	9.0%
Swap differential	–1.0%	–0.5%	+0.5%	+1.5%	+2.0%
Net dollar amount received based on notional value of $100 million	–$1,000,000	–$500,000	+$500,000	+$1,500,000	+$2,000,000
	YEAR				
SCENARIO II	1	2	3	4	5
LIBOR	6.5%	6.0%	5.0%	4.5%	4.0%
Floating rate received	7.5%	7.0%	6.0%	5.5%	5.0%
Fixed rate paid	9.0%	9.0%	9.0%	9.0%	9.0%
Swap differential	–1.5%	–2.0%	–3.0%	–3.5%	–4.0%
Net dollar amount received based on notional value of $100 million	–$1,500,000	–$2,000,000	–$3,000,000	–$3,500,000	–$4,000,000

differential derived for each scenario represents the floating interest rate received minus the fixed interest rate paid. The net dollar amount to be transferred as a result of the swap is determined by multiplying the swap differential by the notional principal. ●

15-2b Forward Swaps

A **forward swap** involves an exchange of interest payments that does not begin until a specified future time. It is useful for financial institutions or other firms that expect to be exposed to interest rate risk at some time in the future.

EXAMPLE

Detroit Bank is currently insulated against interest rate risk. Three years from now, it plans to increase its proportion of fixed-rate loans (in response to consumer demand for these loans) and reduce its proportion of floating-rate loans. In order to prevent the adverse effects of rising interest rates after these changes go into effect, Detroit Bank may want to engage in interest rate swaps. It can immediately arrange for a forward swap that will begin three years from now. The forward swap allows Detroit Bank to lock in the terms of the arrangement today even though the swap period is delayed (see Exhibit 15.5).

Although Detroit Bank could have waited before arranging for a swap, it may prefer a forward swap to lock in the terms of the swap arrangement at the prevailing interest rates. If it expects interest rates to be higher three years from now than they are today, and waits until then to negotiate a swap arrangement, the fixed interest rate specified in the arrangement will likely be higher. A forward interest rate swap may allow Detroit Bank to negotiate a fixed rate today that is less than the expected fixed rate on a swap negotiated in the future. Because Detroit Bank will be exchanging fixed payments for floating-rate payments, it wants to minimize the fixed rate used for the swap agreement. ●

The fixed rate negotiated on a forward swap will not necessarily be the same as the fixed rate negotiated on a swap that begins immediately. The pricing conditions on any swap are based on expected interest rates over the swap's lifetime.

Like any interest rate swap, forward swaps involve two parties. Our example of a forward swap involves a U.S. institution that expects interest rates to rise and wants to immediately lock in the fixed rate that it will pay when the swap period begins. The party that takes the opposite position in the forward swap will likely be a firm that will be adversely affected by declining interest rates and expects interest rates to decline. This firm would prefer to lock in the prevailing fixed rate because that rate is expected to be higher than the applicable fixed rate when the swap period begins. This institution will

Exhibit 15.5 Illustration of a Forward Swap

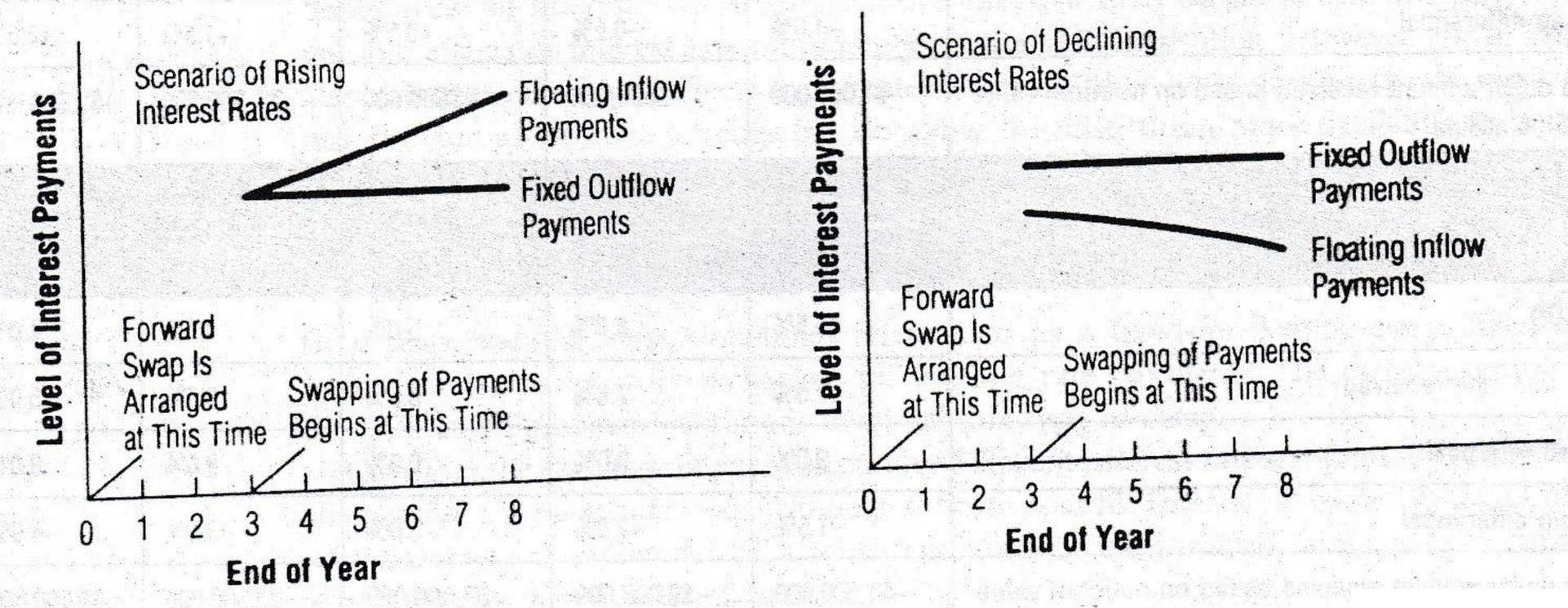
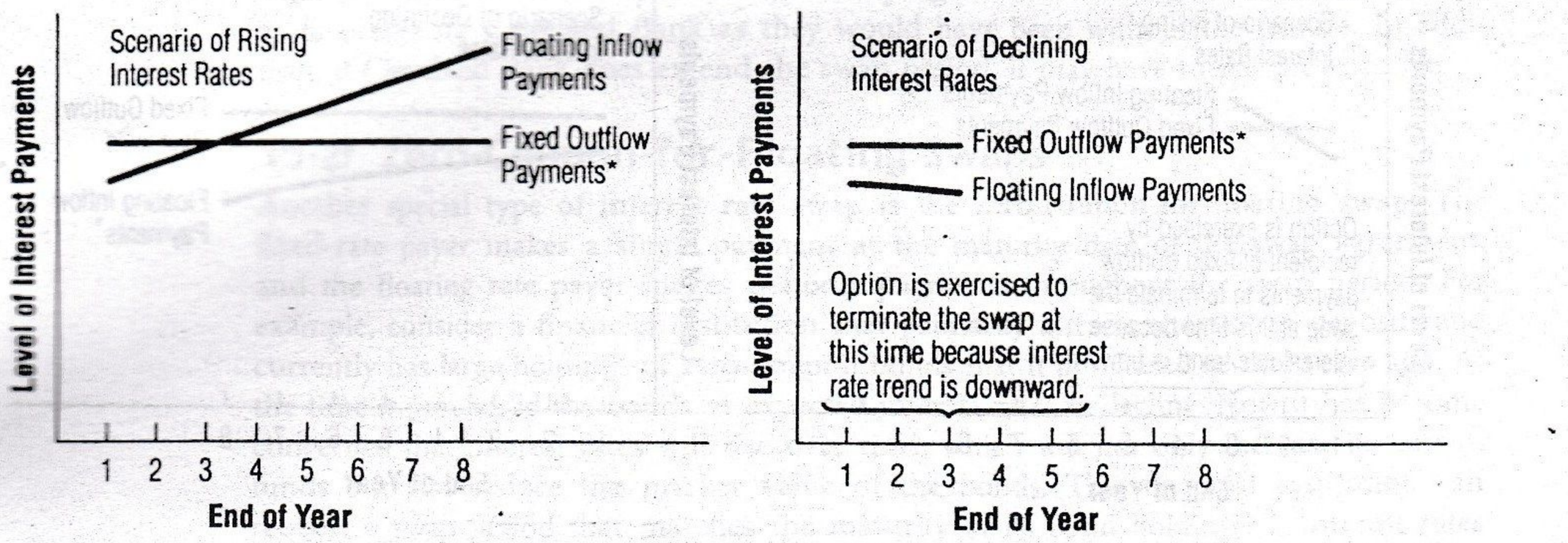


Exhibit 15.6 Illustration of a Callable Swap



**Note that the fixed outflow payments in a callable swap are slightly higher than those in a plain vanilla swap because the payer of the fixed outflow payments incurs the cost for the option to terminate the swap before it matures.*

be receiving the fixed interest payments, so it wishes to maximize the fixed rate specified in the swap arrangement.

15-2c Callable Swaps

Another use of interest rate swaps is through **swap options** (or **swaptions**). A **callable swap** gives the party making the fixed payments the right to terminate the swap prior to its maturity. It allows the fixed-rate payer to avoid exchanging future interest payments if it desires.

EXAMPLE

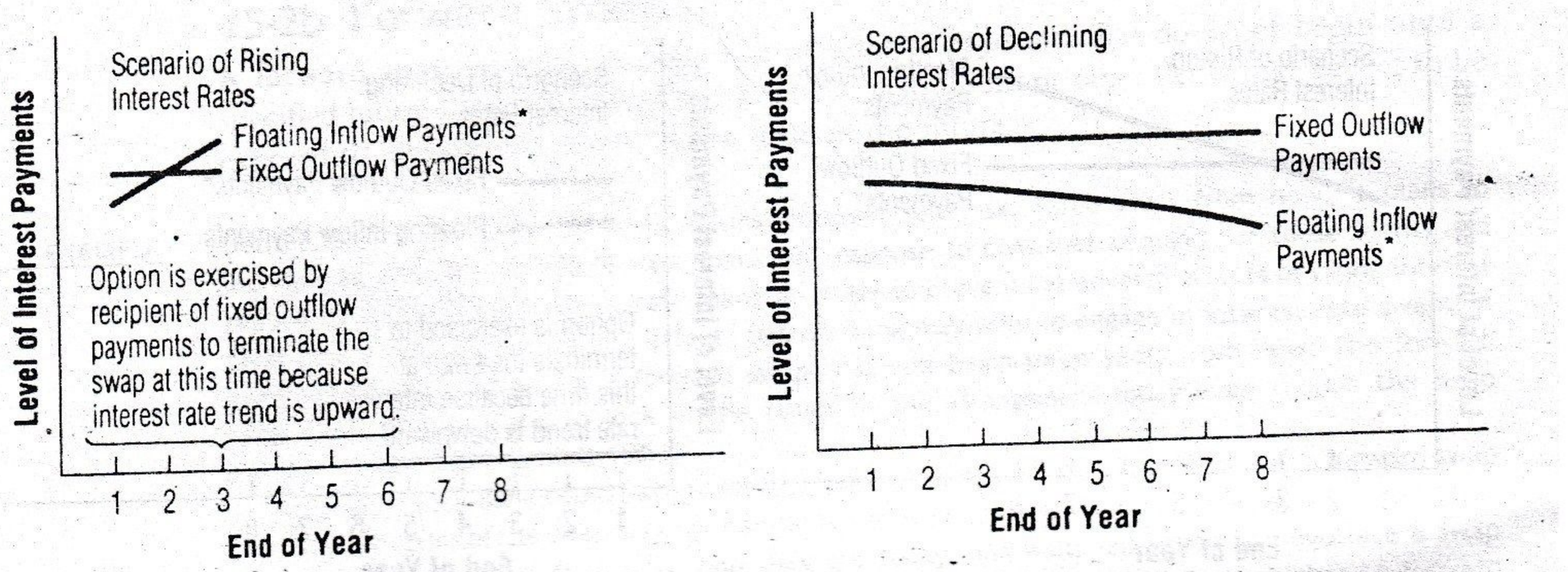
Reconsider the U.S. institution that wanted to swap fixed interest payments for floating interest payments to reduce any adverse effects of rising interest rates. If interest rates decline, the interest rate swap arrangement offsets the potential favorable effects on this institution. A callable swap allows the institution to terminate the swap in the event that interest rates decline (see Exhibit 15.6). ●

The disadvantage of a callable swap is that the party given the right to terminate the swap pays a premium that is reflected in a higher fixed interest rate than that party would pay without the call feature. The party may also incur a termination fee in the event that it exercises its right to terminate the swap arrangement.

15-2d Putable Swaps

A **putable swap** gives the party making the floating-rate payments the right to terminate the swap. To illustrate, reconsider the European institution that wanted to exchange floating-rate payments for fixed-rate payments to reduce the adverse effects of declining interest rates. If interest rates rise, the interest rate swap arrangement offsets the potential favorable effects on the financial institution. A putable swap allows the institution to terminate the swap in the event that interest rates rise (see Exhibit 15.7). As with callable swaps, the party given the right to terminate the swap pays a premium. For putable swaps, the premium is reflected in a higher floating rate than would be paid without the put feature. The party may also incur a termination fee in the event that it exercises its right to terminate the swap arrangement.

Exhibit 15.7 Illustration of a Putable Swap



Note that the floating inflow payments in a putable swap are slightly higher than those in a plain vanilla swap because the payer of the floating inflow payments incurs the cost for the option to terminate the swap before it matures.

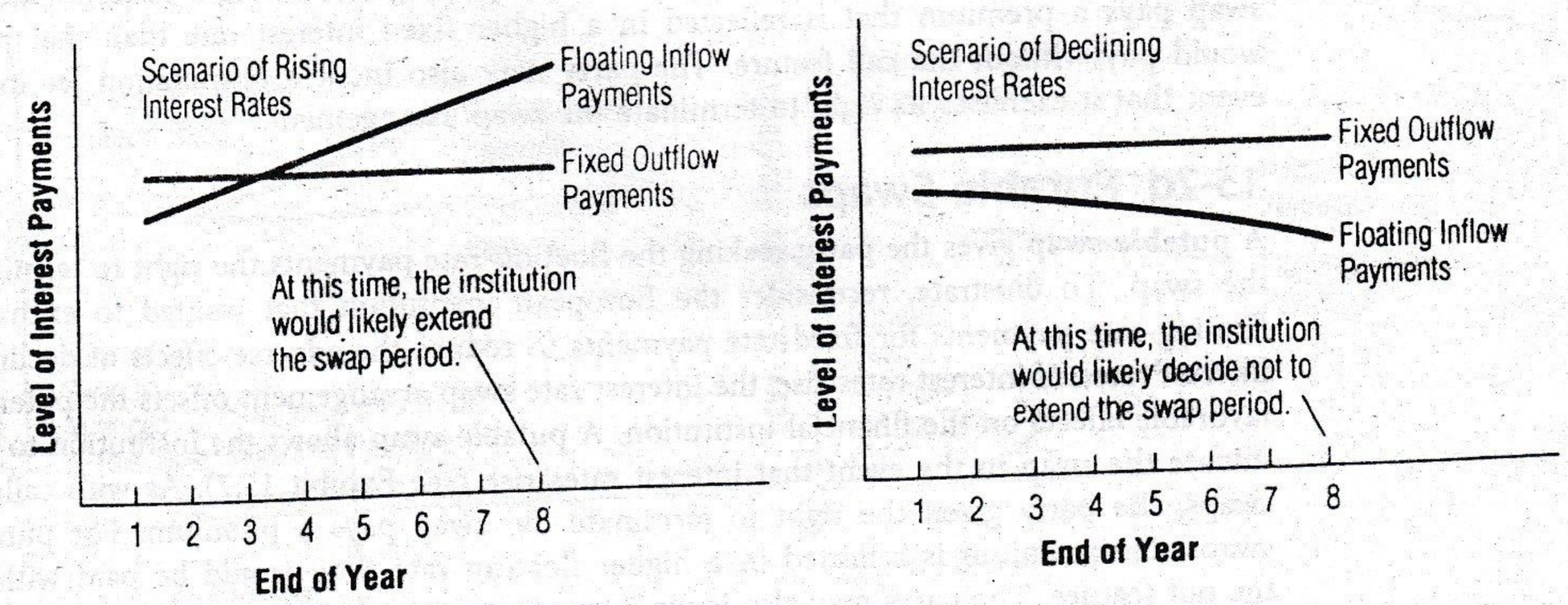
15-2e Extendable Swaps

An **extendable swap** contains a feature that allows the fixed-for-floating party to extend the swap period.

EXAMPLE

Cleveland Bank negotiates a fixed-for-floating swap for eight years. Assume that interest rates increase over this time period as expected. If Cleveland Bank believes interest rates will continue to rise, it may prefer to extend the swap period (see Exhibit 15.8). Although it could create a new swap, the terms would reflect the current economic conditions. A new swap would typically involve an exchange of fixed payments at the prevailing higher interest rate for floating payments.

Exhibit 15.8 Illustration of an Extendable Swap



Cleveland Bank would prefer to extend the previous swap agreement that calls for fixed payments at the lower interest rate that existed at the time the swap was created. It has additional flexibility because of the extendable feature. ●

The terms of an extendable swap reflect a price paid for the extendability feature. That is, the interest rates specified in a swap agreement allowing an extension are not as favorable for Cleveland Bank as they would have been without the feature. In addition, if Cleveland Bank does extend the swap period, it may have to pay an extra fee.

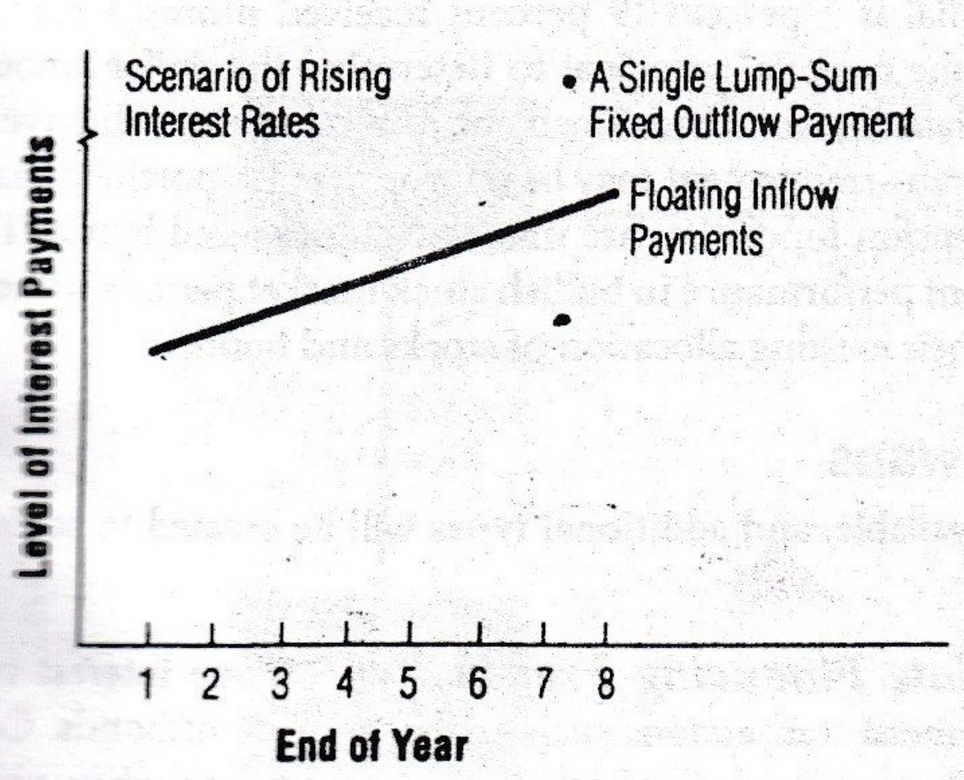
15-2f Zero-Coupon-for-Floating Swaps

Another special type of interest rate swap is the **zero-coupon-for-floating swap**. The fixed-rate payer makes a single payment at the maturity date of the swap agreement, and the floating-rate payer makes periodic payments throughout the swap period. For example, consider a financial institution that primarily attracts short-term deposits and currently has large holdings of zero-coupon bonds that it purchased several years ago. At the time it purchased the bonds, it expected interest rates to decline. Now it has become concerned that interest rates will rise over time, which will not only increase its cost of funds but also reduce the market value of the bonds. This financial institution can request a swap period that matches the maturity of its bond holdings. If interest rates rise over the period of concern, the institution will benefit from the swap arrangement, thereby offsetting any adverse effects on the institution's cost of funds. The other party in this type of transaction might be a firm that expects interest rates to decline (see Exhibit 15.9). Such a firm would be willing to provide floating-rate payments based on this expectation because the payments will decline over time even though the single payment to be received at the end of the swap period is fixed.

15-2g Rate-Capped Swaps

A **rate-capped swap** involves the exchange of fixed-rate payments for floating-rate payments that are capped.

Exhibit 15.9 Illustration of a Zero-Coupon-for-Floating Swap



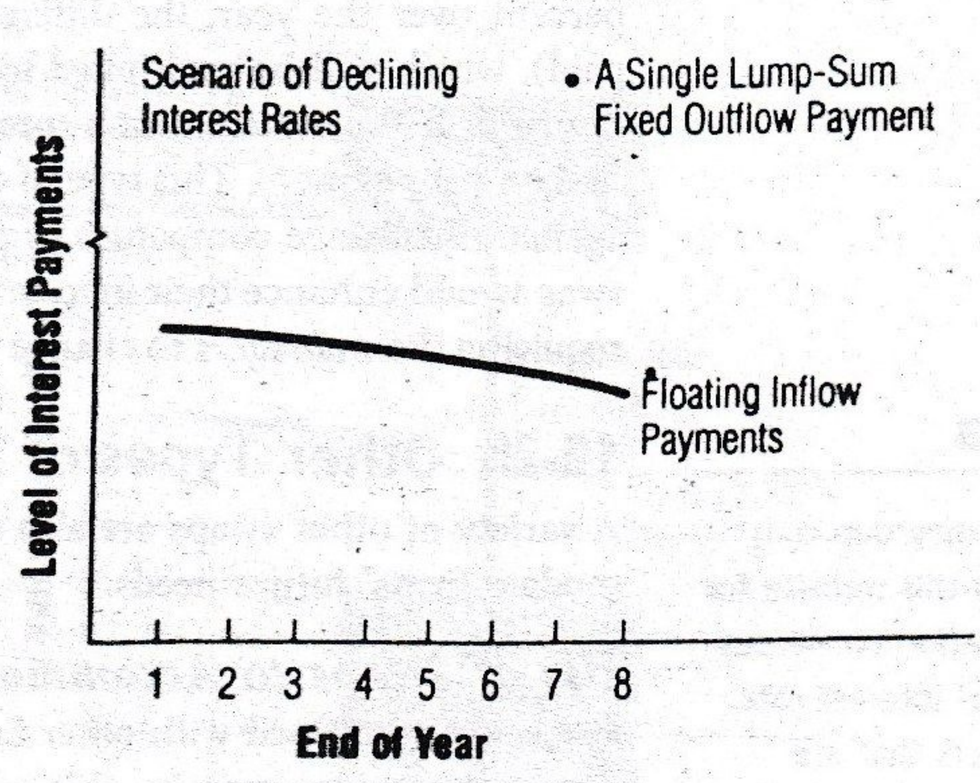
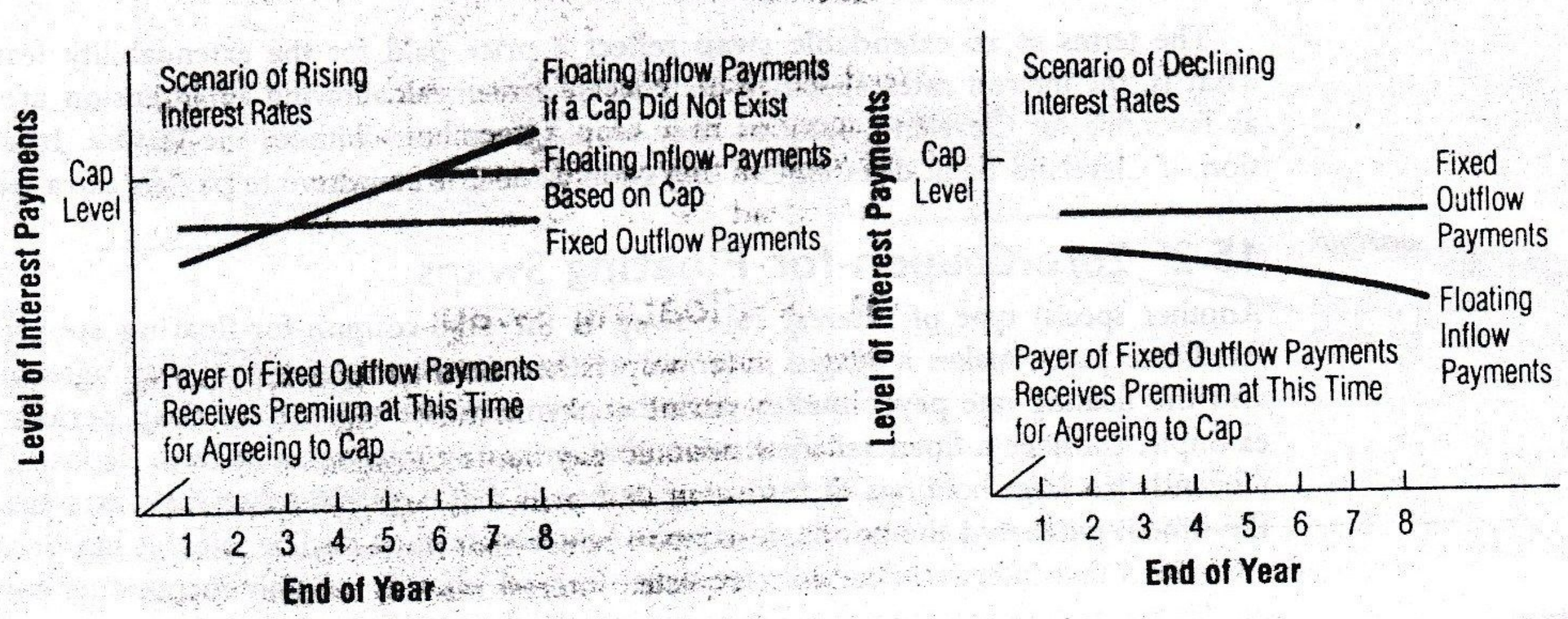


Exhibit 15.10 Illustration of a Rate-Capped Swap Equity Swaps



EXAMPLE

Reconsider the example in which the Bank of Orlando arranges to swap fixed payments for floating payments. The counterparty may want to limit its possible payments by setting a cap or ceiling on the interest rate it must pay. The floating-rate payer pays an up-front fee to the fixed-rate payer for this feature.

In this case, the size of the potential floating payments to be received by the Bank of Orlando would now be limited by the cap, which may reduce the effectiveness of the swap in hedging its interest rate risk. If interest rates rise above the cap, the floating payments received will not move in tandem with the interest the Bank of Orlando will pay depositors for funds (see Exhibit 15.10). Yet the Bank of Orlando might believe that interest rates will not exceed a specified level and would therefore be willing to allow a cap. Moreover, the Bank of Orlando would receive an up-front fee from the counterparty for allowing this cap. ●

An **equity swap** involves the exchange of interest payments for payments linked to the degree of change in a stock index. For example, using an equity swap arrangement, a company could swap a fixed interest rate of 7 percent in exchange for the rate of appreciation on the S&P 500 index each year over a four-year period. If the stock index appreciates by 9 percent over the year, the differential is 2 percent (9 percent received minus 7 percent paid), which will be multiplied by the notional principal to determine the dollar amount received. If the stock index appreciates by less than 7 percent, the company will have to make a net payment. This type of swap arrangement may be appropriate for portfolio managers of insurance companies or pension funds that are managing stocks and bonds. The swap would enhance their investment performance in bullish stock market periods without requiring the managers to change their existing allocation of stocks and bonds.

15-2h Other Types of Swaps

A variety of other swaps are also available, and additional types will be created to accommodate firms' future needs.

Use of Swaps to Accommodate Financing Preferences Some interest rate swaps are combined with other financial transactions such as the issuance of bonds. Corporate borrowers may be able to borrow at a more attractive interest rate when using floating-rate debt than when using fixed-rate debt. Even so, if they want to make fixed

WEB

www.cmegroup.com
Review this website for information on various types of interest rate contracts that are available.

payments on their debt, they can swap fixed-rate payments for floating-rate payments and use the floating-rate payments received to cover their coupon payments. Alternatively, some corporations may prefer to borrow at a floating rate but find it advantageous to borrow at a fixed rate. These corporations can issue fixed-rate bonds and then swap floating-rate payments in exchange for fixed-rate payments.

EXAMPLE Quality Company is a highly rated firm that prefers to borrow at a variable rate. Risky Company is a low-rated firm that prefers to borrow at a fixed rate. These companies would pay the following rates when issuing either variable-rate or fixed-rate Eurobonds:

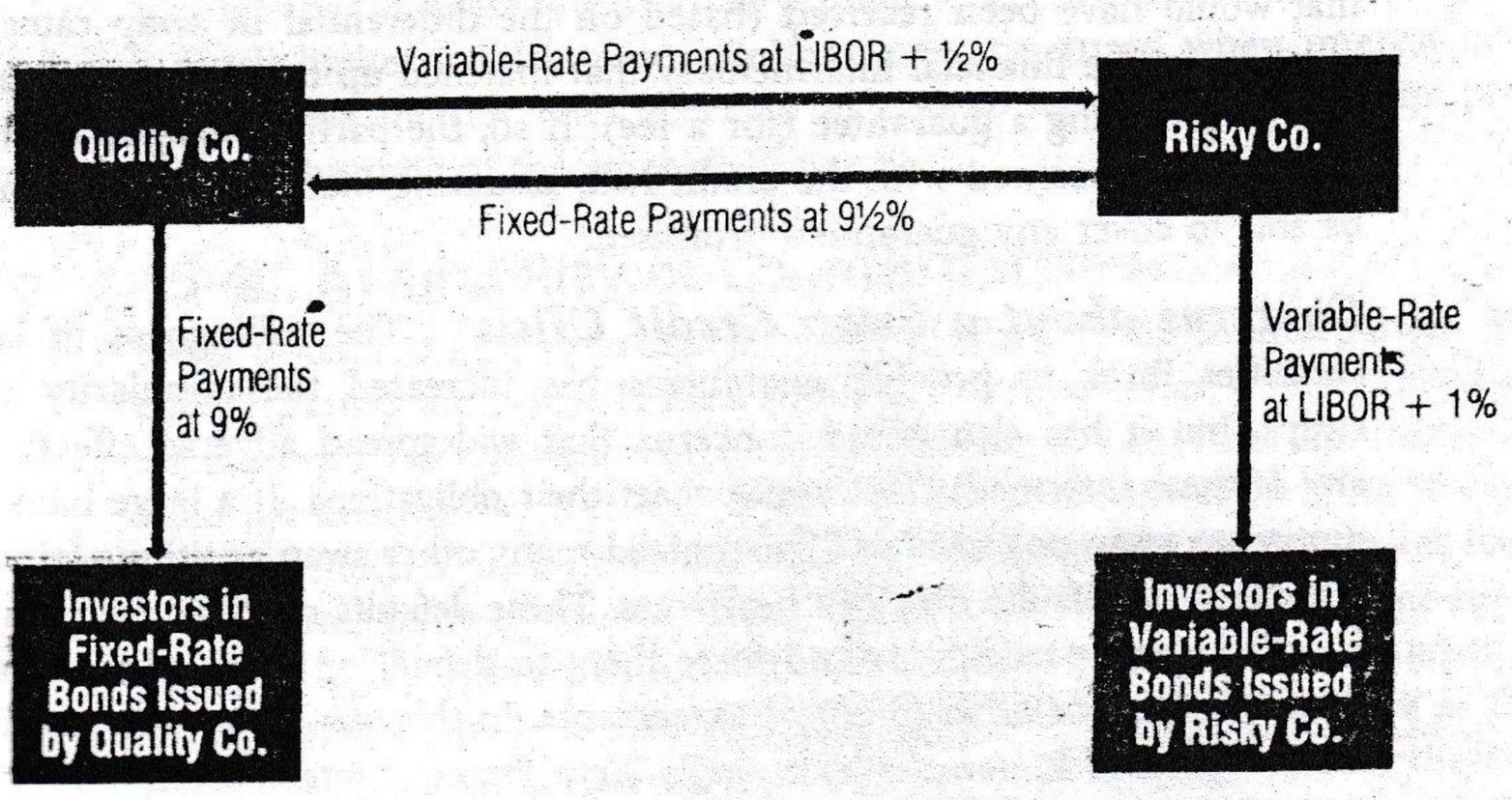
	FIXED-RATE BOND	VARIABLE-RATE BOND
Quality Company	9%	LIBOR + ½%
Risky Company	10½%	LIBOR + 1%

Based on the information given, Quality Company has an advantage when issuing either fixed-rate or variable-rate bonds, but its advantage is greater when issuing fixed-rate bonds. Quality Company could issue fixed-rate bonds while Risky Company issues variable-rate bonds. Quality could then provide variable-rate payments to Risky in exchange for fixed-rate payments.

Assume that Quality negotiated with Risky to provide variable-rate payments at LIBOR plus ½ percent in exchange for fixed-rate payments of 9½ percent. This interest rate swap is shown in Exhibit 15.11. Quality Company benefits because its fixed-rate payments received on the swap exceed the payments owed to bondholders by ½ percent. Its variable-rate payments to Risky Company are the same as what it would have paid if it had issued variable-rate bonds. Risky is receiving LIBOR plus ½ percent on the swap, which is ½ percent less than what it must pay on its variable-rate bonds. However, it is making fixed payments of 9½ percent, which is 1 percent less than it would have paid if it had issued fixed-rate bonds. Overall, it saves ½ percent per year on financing costs. ●

Two limitations of the swap just described are worth mentioning. First, the process of searching for a suitable swap candidate and negotiating the swap terms entails a cost in time and resources. Second, each swap participant faces the risk that the counterparty could default on payments. For this reason, financial intermediaries may match up participants and sometimes assume the credit (default) risk involved (for a fee).

Exhibit 15.11 Illustration of an Interest Rate Swap to Reconfigure Bond Payments



Tax Advantage Swaps Some swaps have recently been used by firms for tax purposes.

EXAMPLE

Columbus, Inc., has exploding tax loss carry forwards from previous years. To utilize the carryforwards before they expire, it may engage in a swap that calls for receipt of a large up-front payment with somewhat less favorable terms over time. However, Columbus may realize an immediate gain on the swap with possible losses in future years. The tax loss carryforwards from previous years can be applied to offset any taxes on the immediate gain from the swap. Any future losses realized from future payments due to the swap agreement may be used to offset future gains from other operations.

Meanwhile, Ann Arbor Co. expects future losses but will realize large gains from operations in this year. It can take a position opposite to that of Columbus. That is, Ann Arbor will arrange for a swap in which it makes an immediate large payment and receives somewhat favorable terms on future payments. This year the firm will incur a tax loss on the swap, which can be used to offset some of its gains from other operations and thereby reduce its tax liability. ●

15-3 Risks of Interest Rate Swaps

Several types of risk must be considered when engaging in interest rate swaps. Three of the more common types of risks are basis risk, credit risk, and sovereign risk.

15-3a Basis Risk

The interest rate of the index used for an interest rate swap will not necessarily move perfectly in tandem with the floating-rate instruments of the parties involved in the swap. For example, the index used on a swap may rise by 0.7 percent over a particular period while the cost of deposits to a U.S. financial institution rises by 1.0 percent over the same period. The net effect is that the higher interest rate payments received from the swap agreement do not fully offset the increase in the cost of funds. This so-called **basis risk** prevents the interest rate swap from completely eliminating the financial institution's exposure to interest rate risk.

15-3b Credit Risk

There is risk that a firm involved in an interest rate swap will not meet its payment obligations. This credit risk is not a deal breaker, however, for the following reasons. As soon as the firm recognizes that it has not received the interest payments it is owed, it will discontinue its payments to the other party. The potential loss is a set of net payments that would have been received (based on the differential in swap rates) over time. In some cases, the financial intermediary that matched up the two parties incurs the credit risk by providing a guarantee (for a fee). If so, the parties engaged in the swap do not need to be concerned with the credit risk, assuming that the financial intermediary will be able to cover any guarantees promised.

Concerns about a Swap Credit Crisis The willingness of large banks and securities firms to provide guarantees has increased the popularity of interest rate swaps, but it has also raised concerns that widespread adverse effects might occur if any of these intermediaries cannot meet their obligations. If a large bank that has taken numerous swap positions and guaranteed many other swap positions fails, there could be a number of defaults on swap payments. These defaults could cause cash flow problems for other swap participants and force them to default on some of their payment obligations on swaps or other financial agreements. In this way, given the global integration of the swap network, defaults by a single large financial intermediary could be transmitted throughout the world. In fact, when American International Group (AIG) was rescued

by the federal government during the credit crisis (as discussed later in this chapter), the potential damage throughout the swap network was cited as a reason for the rescue.

Because of the potential damage that a single shock could cause throughout the swap network, various regulators have considered methods of reducing credit risk in the market. For example, bank regulators have considered forcing banks to maintain more capital if they provide numerous guarantees on swap payments. Other proposals include creating a regulatory agency that would oversee the swap market and minimize credit risk and requiring more complete disclosure of swap positions and guarantees created by financial intermediaries. Given the large growth in swaps, the concerns about credit risk in the market should continue to receive much attention.

15-3c Sovereign Risk

Sovereign risk reflects potential adverse effects resulting from a country's political conditions. Various political conditions could prevent the counterparty from meeting its obligation in the swap agreement. For example, the local government might take over the counterparty and then decide not to meet its payment obligations. Alternatively, the government might impose foreign exchange controls that prohibit the counterparty from making its payments.

Sovereign risk differs from credit risk because it depends on the financial status of the government rather than on the counterparty itself. A counterparty could have very low credit risk but conceivably be perceived as having high sovereign risk because of its government. The counterparty does not have control over some restrictions that may be imposed by its government.

15-4 Pricing Interest Rate Swaps

The setting of specific interest rates for an interest rate swap is referred to as *pricing* the swap. This pricing is influenced by several factors, including prevailing market interest rates, availability of counterparties, and credit and sovereign risk.

15-4a Prevailing Market Interest Rates

The fixed interest rate specified in a swap is influenced by supply and demand conditions for funds having the appropriate maturity. For example, a plain vanilla (fixed-for-floating) interest rate swap structured when interest rates are very high would have a much higher fixed interest rate than one structured when interest rates were low. In general, the interest rates specified in a swap agreement reflect the prevailing interest rates at the time of the agreement.

15-4b Availability of Counterparties

Swap pricing is also determined by the availability of counterparties. When numerous counterparties are available for a particular desired swap, a party may be able to negotiate a more attractive deal. For example, consider a U.S. financial institution that wants a fixed-for-floating swap. If several European institutions are willing to serve as the counterparty, the U.S. institution may be able to negotiate a slightly lower fixed rate.

The availability of counterparties can change in response to economic conditions. For example, in a period when interest rates are expected to rise, many institutions will want a fixed-for-floating swap but few institutions will be willing to serve as the counterparty. The fixed rate specified on interest rate swaps will be higher under these conditions than in a period when many financial institutions expect interest rates to decline.

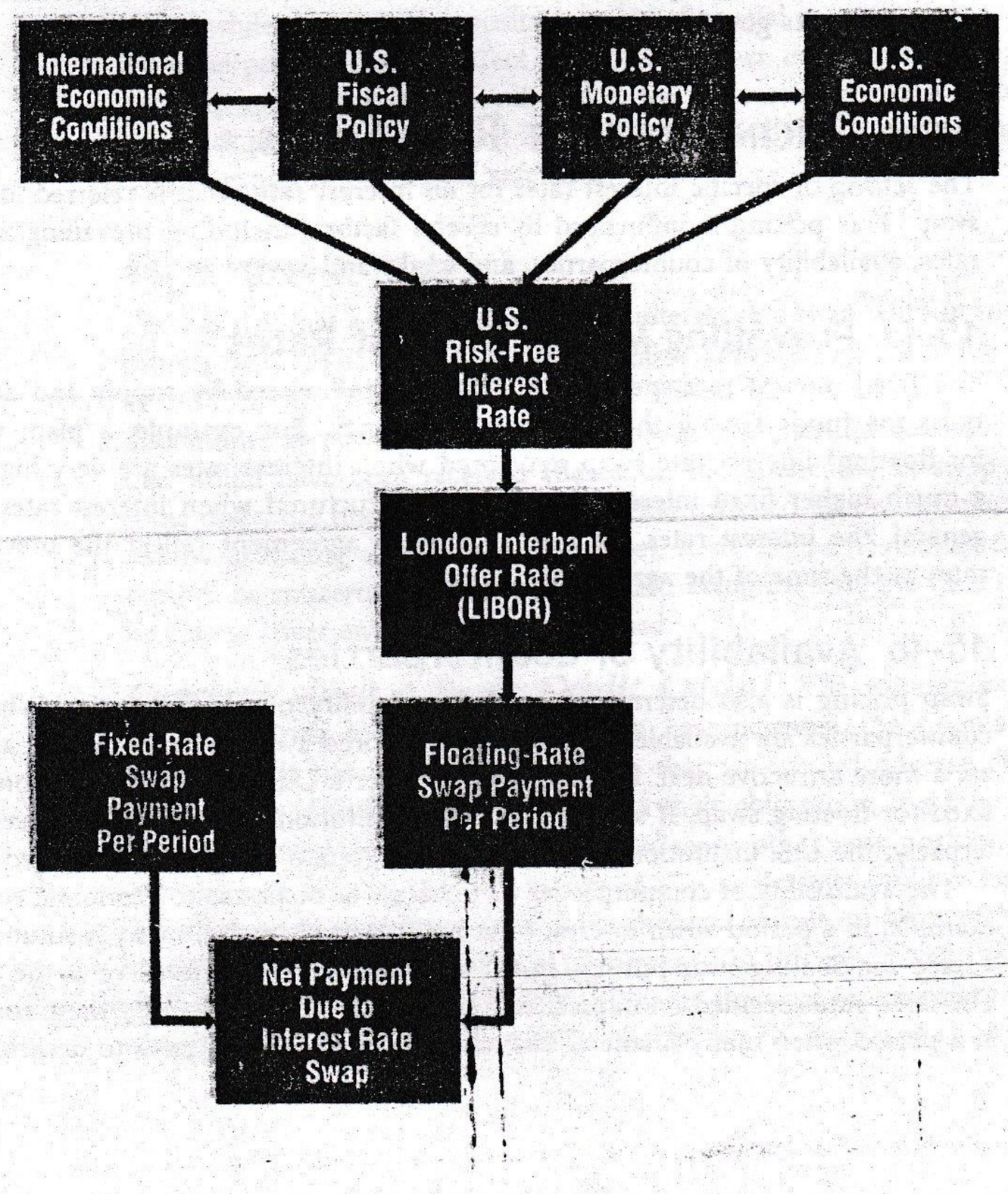
15-4c Credit and Sovereign Risk

A party involved in an interest rate swap must assess the probability of default by the counterparty. For example, a firm that desires a fixed-for-floating swap will likely require a lower fixed rate applied to its outflow payments if the credit risk or sovereign risk of the counterparty is high. If a well-respected financial intermediary guarantees payments by the counterparty, however, the fixed rate will be higher.

15-5 Performance of Interest Rate Swaps

Exhibit 15.12 shows how the performance of an interest rate swap is influenced by several underlying forces that affect interest rate movements. The impact of the underlying forces on the performance of an interest rate swap depends on the party's swap position. For example, to the extent that strong economic growth can increase interest rates, it will be beneficial for a party that is swapping fixed-rate payments for floating-rate payments but detrimental to a party that is swapping floating-rate payments for fixed-rate payments.

Exhibit 15.12 Framework for Explaining Net Payments Resulting from an Interest Rate Swap



The diagram in Exhibit 15.12 can be adjusted to fit any currency. For an interest rate swap involving an interest rate benchmark denominated in a foreign currency, the economic conditions of that country are the primary forces that determine interest rate movements in that currency and thereby the performance of the interest rate swap.

Because the performance of a particular interest rate swap position is normally influenced by future interest rate movements, participants in the interest rate swap market closely monitor indicators that may affect these movements. Among the more closely watched indicators are indicators of economic growth (employment, gross domestic product), indicators of inflation (consumer price index, producer price index), and indicators of government borrowing (budget deficit, expected volume of funds borrowed at upcoming Treasury bond auctions).

15-6 Interest Rate Caps, Floors, and Collars

In addition to the more traditional forms of interest rate swaps, three other interest rate derivative instruments are commonly used:

- Interest rate caps
- Interest rate floors
- Interest rate collars

These instruments are normally classified separately from interest rate swaps, but they do result in interest payments between participants. Each of these instruments can be used by financial institutions to capitalize on expected interest rate movements or to hedge their interest rate risk.

15-6a Interest Rate Caps

An **interest rate cap** offers payments in periods when a specified interest rate index exceeds a specified ceiling (cap) interest rate. The payments are based on the amount by which the interest rate exceeds the ceiling, multiplied as usual by the notional principal specified in the agreement. A fee is paid upfront to purchase an interest rate cap, and the lifetime of a cap commonly ranges between three and eight years.

The typical purchaser of an interest rate cap is a financial institution that is adversely affected by rising interest rates. If interest rates rise, the payments received from the interest rate cap agreement will help offset any adverse effects.

The seller of an interest rate cap receives the fee paid upfront and is obligated to provide periodic payments when the prevailing interest rates exceed the ceiling rate specified in the agreement. The typical seller of an interest rate cap is a financial institution that expects interest rates to remain stable or to decline.

Large commercial banks and securities firms serve as dealers for interest rate caps in which they act as the counterparty to the transaction. They also serve as brokers, matching up participants that wish to purchase or sell interest rate caps. They may even guarantee (for a fee) the interest payments that are to be paid to the purchaser of the interest rate cap over time.

EXAMPLE Assume that Buffalo Savings Bank purchases a five-year cap for a fee of 4 percent of notional principal valued at $60 million (so the fee is $2.4 million) with an interest rate ceiling of 10 percent. The agreement specifies LIBOR as the index used to represent the prevailing market interest rate.

Assume that LIBOR moved over the next five years as shown in Exhibit 15.13. Based on these movements in LIBOR, Buffalo Savings Bank received payments in three of the five years. The amount received by Buffalo in any year is based on the percentage points above the 10 percent ceiling multiplied by the notional principal. For example, in Year 1 the payment is zero because LIBOR was below

Exhibit 15.13 Illustration of an Interest Rate Cap

	END OF YEAR					
	0	1	2	3	4	5
LIBOR		6%	11%	13%	12%	7%
Interest rate ceiling		10%	10%	10%	10%	10%
LIBOR's percent above the ceiling		0%	1%	3%	2%	0%
Payments received (based on $60 million of notional principal)		$0	$600,000	$1,800,000	$1,200,000	$0
Fee paid	$2,400,000					

the ceiling rate. In Year 2, however, LIBOR exceeded the ceiling by 1 percentage point and so Buffalo received a payment of $600,000 (0.01 × $60 million). To the extent that Buffalo's performance is adversely affected by high interest rates, the interest rate cap creates a partial hedge by providing payments to Buffalo that are proportionately related to the interest rate level. The seller of the interest rate cap in this example had the opposite payments of those shown for Buffalo in Exhibit 15.13. ●

Interest rate caps can be devised to meet various risk-return profiles. For example, Buffalo Savings Bank could have purchased an interest rate cap with a ceiling rate of 9 percent to generate payments whenever interest rates exceeded that ceiling. The bank would have had to pay a higher up-front fee for this interest rate cap, however.

15-6b Interest Rate Floors

An **interest rate floor** offers payments in periods when a specified interest rate index falls below a specified floor rate. The payments are based on the amount by which the interest rate falls below the floor rate, which is multiplied by the notional principal specified in the agreement. A fee is paid upfront to purchase an interest rate floor, and the lifetime of the floor commonly ranges between three and eight years. The interest rate floor can be used to hedge against lower interest rates in the same manner that the interest rate cap hedges against higher interest rates. Any financial institution that purchases an interest rate floor will receive payments if interest rates decline below the floor, and these payments will help offset any adverse interest rate effects.

The seller of an interest rate floor receives the fee paid upfront and is obligated to provide periodic payments when the interest rate on a specified money market instrument falls below the floor rate specified in the agreement. The typical seller of an interest rate floor is a financial institution that expects interest rates to remain stable or to rise. Large commercial banks or securities firms serve as dealers and/or brokers of interest rate floors, just as they do for interest rate swaps or caps.

EXAMPLE

Assume that Toland Finance Company purchases a five-year interest rate floor for a fee of 4 percent of notional principal valued at $60 million (so the fee is $2.4 million) with an interest rate floor of 8 percent. The agreement specifies LIBOR as the index used to represent the prevailing interest rate.

Assume that LIBOR moved over the next five years as shown in Exhibit 15.14. Based on these movements in LIBOR, Toland received payments in two of the five years. The dollar amount received by Toland in any year is based on the percentage points below the 8 percent floor multiplied by the notional principal. In Year 1, for example, LIBOR was 2 percentage points below the interest rate floor and so Toland received a payment of $1.2 million (0.02 × $60 million). The seller of the interest rate floor in this example had the opposite payments of those shown for Toland in Exhibit 15.14. ●

Exhibit 15.14 Illustration of an Interest Rate Floor

	END OF YEAR:					
	0	1	2	3	4	5
LIBOR		6%	11%	13%	12%	7%
Interest rate floor		8%	8%	8%	8%	8%
LIBOR's percent below the floor		2%	0%	0%	0%	1%
Payments received (based on $60 million of notional principal)		$1,200,000	$0	$0	$0	$600,000
Fee paid	$2,400,000					

15-6c Interest Rate Collars

An **interest rate collar** involves the purchase of an interest rate cap and the simultaneous sale of an interest rate floor. In its simplest form, the up-front fee received from selling the interest rate floor to one party can be used to pay the fee for purchasing the interest rate cap from another party. Any financial institution that desires to hedge against the possibility of rising interest rates can purchase an interest rate collar. The hedge results from the interest rate cap, which will generate payments to the institution if interest rates rise above the interest rate ceiling.

Because the collar also involves the sale of an interest rate floor, the financial institution is obligated to make payments if interest rates decline below the floor. However, if interest rates rise as expected then the rates will remain above the floor, so the financial institution will not have to make payments.

EXAMPLE

Assume that Pittsburgh Bank's performance is inversely related to interest rates. It anticipates that interest rates will rise over the next several years and decides to hedge its interest rate risk by purchasing a five-year interest rate collar, with LIBOR as the index used to represent the prevailing interest rate. The interest rate cap specifies a fee of 4 percent of notional principal valued at $60 million (so the fee is $2.4 million) with an interest rate ceiling of 10 percent. The interest rate floor specifies a fee of 4 percent of notional principal valued at $60 million and an interest rate floor of 8 percent.

Assume that LIBOR moved over the next five years as shown in Exhibit 15.15. Based on these movements in LIBOR, the payments received from purchasing the interest rate cap and the payments made from selling the interest rate floor are derived separately over each of the five years.

Because the fee received from selling the interest rate floor was equal to the fee paid for the interest rate cap, the initial fees offset. The net payments received by Pittsburgh Bank as a result of purchasing the collar are equal to the payments received from the interest rate cap minus the payments made as a result of the interest rate floor. In the years when interest rates were relatively high, the net payments received by Pittsburgh Bank were positive.

As this example illustrates, when interest rates are high, the collar can generate payments that may offset the adverse effects of the high interest rates on the bank's normal operations. Although the net payments were negative in those years when interest rates were low, the performance of the bank's normal operations should have been strong. Like many other hedging strategies, the interest rate collar reduces the sensitivity of the financial institution's performance to interest rate movements. ●

Exhibit 15.15 Illustration of an Interest Rate Collar (Combined Purchase of Interest Rate Cap and Sale of Interest Rate Floor)

	END OF YEAR:					
	0	1	2	3	4	5
Purchase of interest rate cap:						
LIBOR		6%	11%	13%	12%	7%
Interest rate ceiling		10%	10%	10%	10%	10%
LIBOR's percent above the ceiling		0%	1%	3%	2%	0%
Payments received		$0	$600,000	$1,800,000	$1,200,000	$0
Fee paid	$2,400,000					
Sale of interest rate floor:						
Interest rate floor		8%	8%	8%	8%	8%
LIBOR's percent below the floor		2%	0%	0%	0%	1%
Payments made		$1,200,000	$0	$0	$0	$600,000
Fee received	$2,400,000					
Fee received minus fee paid	$0					
Payments received minus payments made		–$1,200,000	+$600,000	+$1,800,000	+$1,200,000	–$600,000

15-7 Credit Default Swaps

A **credit default swap** (CDS) is a privately negotiated contract that protects investors against the risk of default on particular debt securities. The main participants in the CDS market are commercial banks, insurance companies, hedge funds, and securities firms. The swap involves two parties that have different needs or expectations about the future performance of particular debt securities. One party is the buyer, who is willing to provide periodic (usually quarterly) payments to the other party, the seller. Thus, the seller receives the payments from the buyer but is obligated to reimburse the buyer if the securities specified in the swap agreement default. In this case, the seller pays the par value of the securities in exchange for the securities. Alternatively, the securities may be auctioned off by the buyer, in which case the seller must pay the buyer of the CDS the difference between the par value of the securities and the price at which those securities were sold.

The buyer of a CDS is protected if the securities specified in the CDS contract default. Financial institutions purchase CDS contracts to protect their own investments in debt securities against default risk. The seller of a CDS expects that the CDS is unlikely to default. If its expectations come true, it will not have to make a payment and therefore benefits from the quarterly payments it receives over the life of the CDS contract.

EXAMPLE

Last year, Inve Co. purchased bonds (issued by Zykmo Co.) with a par value of $30 million. Since then, Inve has become concerned that the bonds it purchased could default over the next five years. Inve Co. therefore purchases a CDS on these bonds. The CDS refers to Zykmo Co. as the reference entity, since

that is the company for which credit protection is purchased. The maximum amount to be paid (notional principal) of this CDS is $30 million. A financial institution is willing to sell the CDS contract for these bonds over the five years for a premium of 2 percent of the value per year, or 0.02 × $30 million = $600,000. Inve Co. needs to make a quarterly premium of $150,000 to cover the $600,00 payment over one year. If at any time over the next five years Zykmo Co. files for bankruptcy and the bonds become worthless, Inve would not make any additional payments and the seller of the CDS contract would be obligated to pay Inve Co. $30 million. If, however, the bonds do not default over the next five years (i.e., while the CDS contract exists), Inve Co. would make quarterly payments until maturity. In this case, the seller of the CDS contract is not obligated to pay any funds to Inve Co., and it received $600,000 annually for five years because it was willing to insure the bonds. ●

This example is simplified in that it focuses on insuring against default of one particular type of bond issued by one firm. Many CDS contracts insure against default of mortgage-backed securities that represent bundles of mortgages.

The maturity of a CDS is typically between 1 and 10 years, but the most common maturity is 5 years. The notional value of the securities represented by a CDS contract is typically between $10 million and $20 million. The CDS contracts are traded over the counter and are not backed by an organized exchange.

15-7a Secondary Market for CDS Contracts

There is a secondary market for CDS contracts in which CDS dealers serve as intermediaries. Some of the major dealers that facilitate secondary market transactions include Goldman Sachs, Citigroup, Bank of America, and Morgan Stanley. The secondary market allows financial institutions participating in a CDS contract to pass on their obligations to other willing parties.

When the securities protected by a CDS contract decline in price because of conditions that increase the likelihood of their default, the seller of the CDS must post a higher level of collateral to back its position. This requirement is intended to ensure that the seller of the CDS does not default on its position.

15-7b Collateral on CDS Contracts

The value of a CDS contract is known only by the dealer serving as intermediary between buyer and seller, and transaction prices are not publicized. Without transparency, dealers may not acknowledge that the market price of a specific CDS contract has changed, especially if their position would force them to post more collateral in response to a change in price. Furthermore, if there is not much activity in the secondary market then today's valuation of the CDS may be based on the price of the last transaction for that type of CDS that occurred several weeks ago. If the prevailing valuation is inaccurate, the amount of collateral posted might not be sufficient to cover potential losses to a participant. The lack of transparency in CDS pricing has caused conflicts regarding the levels of collateral to be held and has resulted in lawsuits.

15-7c Payments on a Credit Default Swap

Holding maturity and notional value constant, the payments required on a new CDS are positively related to the default risk. For example, a CDS on $10 million of debt securities that have a relatively low likelihood of default may require an annual payment of 1 percent or $100,000 per year (divided into quarterly payments). A CDS on $10 million of riskier debt securities might require an annual payment of 3 percent, or $300,000 per year. A seller of a CDS requires more compensation to provide protection against default if the likelihood of default is higher.

In periods when economic growth is strong, the payments required on a CDS contract on most securities should be relatively low because the default risk is usually low under these conditions. When economic conditions are weak, the payments required on a CDS contract on most securities should be relatively high because the default risk is high.

15-7d How CDS Contracts Affect Debtor-Creditor Negotiations

When a firm encounters financial problems, its creditors attempt to work with the firm to prevent it from going bankrupt. They may be willing to help the debtor firm avoid bankruptcy by accepting a fraction of what they are owed, since they may receive even less if the firm files for bankruptcy. Yet if the creditors have purchased a CDS contract, they may benefit more if the debtor firm goes bankrupt because then they will receive payment from the seller of the CDS. Thus, creditors who hold CDS contracts have less incentive to help a debtor firm avoid bankruptcy.

15-7e Development of the CDS Market

Credit default swaps were created in the 1990s as a way to protect bond-purchasing investors against default risk. Over time, CDS contracts were adapted to protect investors that purchased mortgage-backed securities. The CDS market grew rapidly and represented $2 trillion of notional principal in 2003, $13 trillion in 2006, and $35 trillion in 2009. (These values count each contract only once, even though there are two parties involved, in order to avoid double-counting.)

One reason for this rapid growth was that many financial institutions that invested in mortgage-backed securities wanted to purchase CDS contracts in order to protect against default. Other financial institutions that believed the mortgage-backed securities were safe served as the counterparties in order to generate periodic income. The CDS market is estimated to be more than five times the size of the mortgage market, more than seven times the market for U.S. Treasury securities, and more than twice the size of the U.S. stock market.

15-7f Impact of the Credit Crisis on the CDS Market

Many financial institutions accumulated large holdings of mortgage-backed securities during the housing boom in the 2003–2005 period. They may have believed that the return was favorable and that the risk was negligible because home prices were rising consistently. As the housing market began to weaken in 2006, they purchased CDS contracts as protection against the default of these mortgage-backed securities.

Using CDS Contracts to Bet on Mortgage Defaults During the 2003–2006 housing boom, the economy was strong, mortgage companies applied loose standards when granting mortgages, and rating agencies rated mortgage-backed securities (MBS) highly even when they contained subprime mortgages. Some institutional investors were willing to purchase mortgages and MBS because they presumed that households would continue to make their mortgage payments or that home values would remain high enough to provide sufficient collateral to cover against defaults. Housing prices continued to rise during this period, but households were able to obtain home mortgages anyway because of a general perception that home prices would continue to rise. These conditions signaled the likelihood of a housing price bubble that was about to burst.

Some financial institutions that anticipated a major decline in housing prices purchased CDS contracts on MBS even when they had no exposure to MBS. That is, they were not hedging an existing position but instead were simply taking a speculative position based on their expectations that many mortgages would default. The cost of their bet was the periodic premium they paid to sellers of the CDS contracts; their potential

benefit was the money that they would be owed if the MBS specified by their CDS contracts defaulted before the contract matured.

EXAMPLE

In 2006, Spec Co. purchased a CDS contract that protected against the default on specific mortgage-backed securities, with a notional principal of $20 million, that stipulated Spec Co. would make quarterly payments of $200,000. Spec Co. was not hedging a position, since it had not invested in any mortgage-backed securities, but rather believed that the specific mortgage-backed security in the CDS contract would default. In 2009, the mortgage-backed security defaulted and so Spec Co. received $20 million from the seller of the CDS. ●

During the credit crisis, many MBS defaulted; this generated large profits for the buyers of CDS contracts and major losses for the sellers. Not all MBS were the same, and some had a much higher probability of failure. Some speculators targeted MBS that contained subprime mortgages because these mortgages were more likely to default. Many of these MBS were rated highly even though they contained subprime mortgages. Speculators could easily find sellers of the CDS contracts they wanted to buy, because many sellers of CDS contracts (wrongly) presumed that any MBS rated highly by the agencies had a low risk of default.

Insufficient Margins on CDS Contracts During the credit crisis, many credit default swaps did not have a sufficient margin backing the agreement. The assets (such as mortgage-backed securities) referenced by these swaps were not standardized and therefore were not traded on a frequent basis. Thus the market prices of the assets were uncertain. Even when an asset was likely to fail, there was no documented market value that could force the seller of the credit default swap to post a larger margin. By the time the asset officially failed, the margin covered only a small portion of the payment that the seller of the credit default swap owed the buyer of that swap. Although it was typical for the underlying assets referenced in a credit default swap to be rated, this rating was not always adjusted to reflect conditions that increased the probability of the asset defaulting.

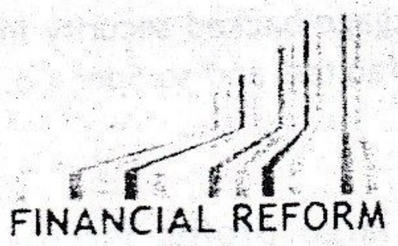
Impact of Lehman Brothers' Failure The securities firm Lehman Brothers was a major participant in the CDS market. When it went bankrupt in September 2008, it did not cover all of its CDS obligations. Thus many financial institutions that had purchased CDS contracts from Lehman to protect against the default of mortgage-backed securities were not protected once the firm went bankrupt. Since the CDS market was over-the-counter at the time, there was little information about the exposure of financial institutions to CDS contracts. The credit crisis illustrated how protection provided to buyers of a CDS is only as good as the creditworthiness of the CDS seller.

Another impact of the Lehman Brothers failure was that participants recognized that the government will not automatically rescue all large financial institutions. Thus the annual payments necessary to buy new CDS contracts on large financial institutions increased substantially shortly after the Lehman Brothers failure. Sellers of new CDS contracts required higher payments because the risk premium on the CDS contracts increased. The sellers were willing to sell CDS contracts only if they received higher payments that would compensate for the higher risk.

Impact of AIG's Financial Problems American International Group, the world's largest insurance company, frequently sold CDS contracts as a means of generating periodic revenue. By 2008, it was on the sale side of CDS contracts representing about $440 billion in debt securities. Many of its CDS contracts obligated AIG to cover risky, mortgage-backed securities that represented subprime mortgages. As housing conditions weakened further, rumors circulated that AIG might not be able to cover all the future

claims on its CDS contracts due to defaults. The federal government was concerned that if AIG could not satisfy its obligations, all the financial institutions that had purchased CDS contracts from AIG would lose their protection and might fail. In September 2008, the Federal Reserve injected billions of dollars into AIG because it feared the company's failure would cause major damage to the financial sector. In the following months, the bailout continued. By early 2009, AIG had received $150 billion in government funds.

15-7g Reform of CDS Contracts



As a result of the Financial Reform Act of 2010, derivative securities such as swaps are to be traded on an exchange or clearinghouse. The Commodity Futures Trading Commission and the Securities and Exchange Commission are expected to play an important role in developing specific rules that apply to the trading of swap contracts in the future. One obvious result of having derivatives traded on an exchange or clearinghouse instead of over the counter is that the derivative contracts should become more standardized. Second, the pricing of these contracts should become more transparent, as the exchange should post prices paid for the standardized derivative contracts that are traded on the exchange.

Third, the use of standardized contracts should increase the trading volume, which in turn should reduce the uncertainty surrounding the price of a standardized derivative contract. That is, one may have more confidence in the valuation of a swap contract that is based on many transactions as opposed to a single, over-the-counter transaction. Fourth, market participants and regulators should be more informed about the use of particular swap contracts if they are traded on an exchange, because the exchange should publicize the trading volume per contract.

Given that an exchange should result in more accurate pricing of the swap contracts, the amount of collateral backing any participant's contract should be more accurate as well. Thus, even if a participant defaults on its obligation to pay on a particular contract, the exchange should have access to sufficient collateral to cover the payment. In this manner, a possible default in any contract should not cause possible contagion effects for other counterparties of swap contracts.

The Chicago Mercantile Exchange (CME) offers futures contracts on interest rate swaps. These contracts allow participants to engage in interest rate swaps, but with the efficiency and transparency of a futures contract.

15-8 Globalization of Swap Markets



The market for interest rate swaps is not restricted to the United States. As mentioned earlier, European financial institutions commonly have the opposite exposure to interest rate risk and therefore take swap positions counter to the positions desired by U.S. financial institutions. Manufacturing corporations from various countries that are exposed to interest rate risk also engage in interest rate swaps.

Interest rate swaps are executed in various countries and are denominated in many different currencies. Dollar-denominated interest rate swaps account for about half the value of all interest rate swaps outstanding.

Given that swap participants are from various countries, the banks and securities firms that serve as intermediaries have a globalized network of subsidiaries. In this way, they can link participants from various countries. One obvious barrier to the global swap market is the lack of information about participants based in other countries. Thus, concerns about credit risk may discourage some participants from engaging in swaps. This barrier is reduced when international banks and securities firms that serve as intermediaries are willing to back the payments that are supposed to occur under the provisions of the swap agreement.

Financial institutions from numerous countries also participated in the credit default swap market. Some of them were attempting to protect against default risk of their investments in bonds issued by governments around the world. In fact, some of the most popular CDS contracts were written on bonds issued by governments of emerging markets such as Brazil, Russia, and Turkey. Because CDS contracts were traded internationally, the credit crisis spread globally as participants began to realize that their counterparties might not be able to fulfill their obligations.

15-8a Currency Swaps

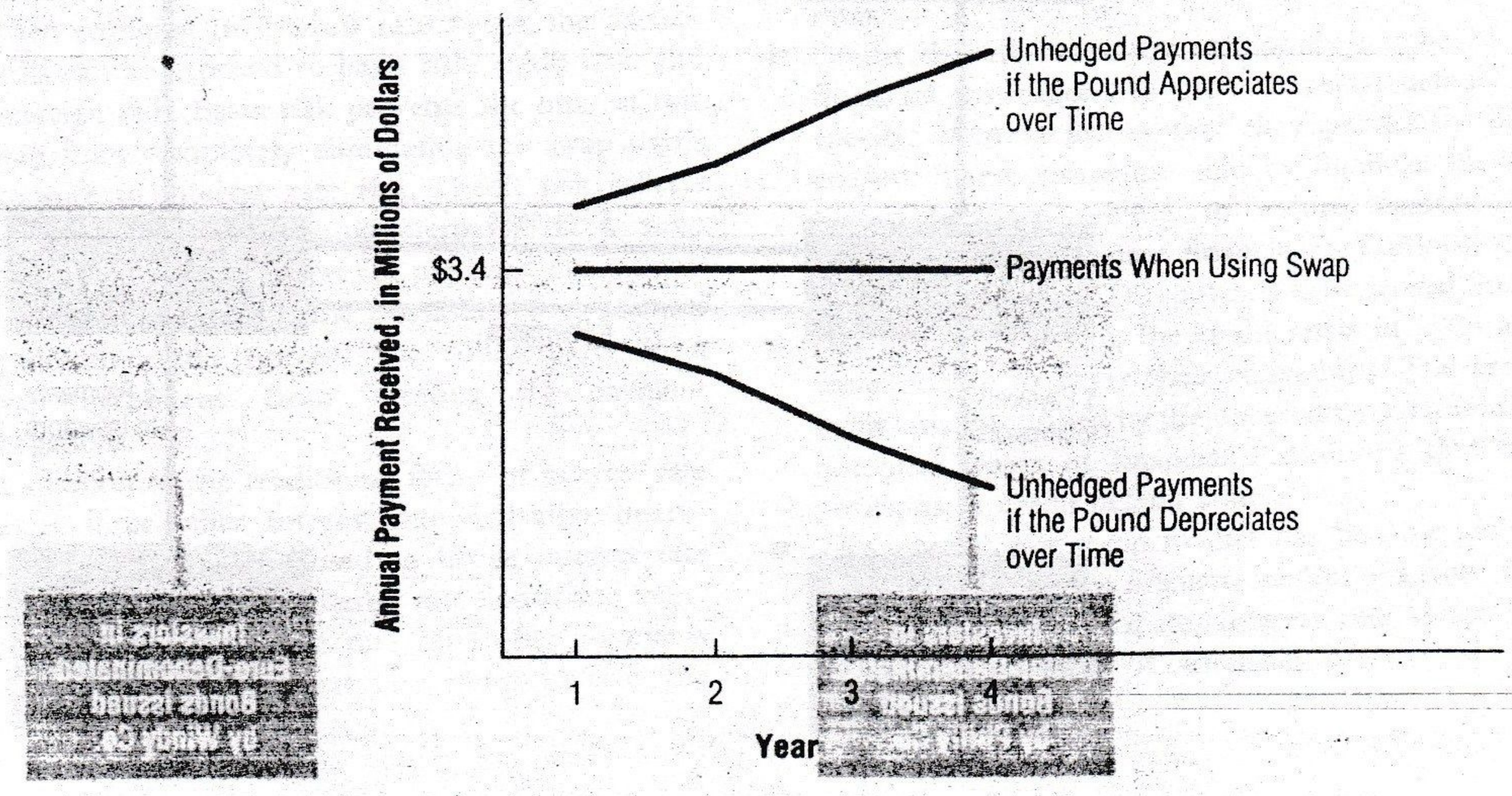
A **currency swap** is an arrangement whereby currencies are exchanged at specified exchange rates and at specified intervals. It is essentially a combination of currency futures contracts, although most futures contracts are not available for periods in the distant future. Currency swaps are commonly used by firms to hedge their exposure to exchange rate fluctuations.

EXAMPLE

Springfield Company is a U.S. firm that expects to receive 2 million British pounds (£) in each of the next four years. It may therefore want to lock in the exchange rate at which it can sell British pounds over the next four years. A currency swap will specify the exchange rate at which the £2 million can be exchanged in each year. Assume the exchange rate specified by a swap is $1.70 (the spot exchange rate at the time of the swap arrangement), so Springfield will receive $3.4 million (£2 million × $1.70 per £) in each of the four years. If the firm does not engage in a currency swap, the dollar amount received will depend on the spot exchange rate at the time the pounds are converted to dollars.

The impact of the currency swap is illustrated in Exhibit 15.16. This exhibit also shows the payments that would have been received under two alternative scenarios if the currency swap had not been arranged. Note that the payments received from the swap would have been less favorable than the unhedged strategy if the pound appreciated against the dollar over that period. However, the payments received from the swap would have been more favorable than the unhedged strategy

Exhibit 15.16 Impact of Currency Swaps



if the pound depreciated against the dollar over that period. The currency swap arrangement reduces the firm's exposure to changes in the pound's value. ●

The large commercial banks that serve as financial intermediaries sometimes take positions. That is, they may agree to swap currencies with a firm rather than simply search for a suitable swap candidate.

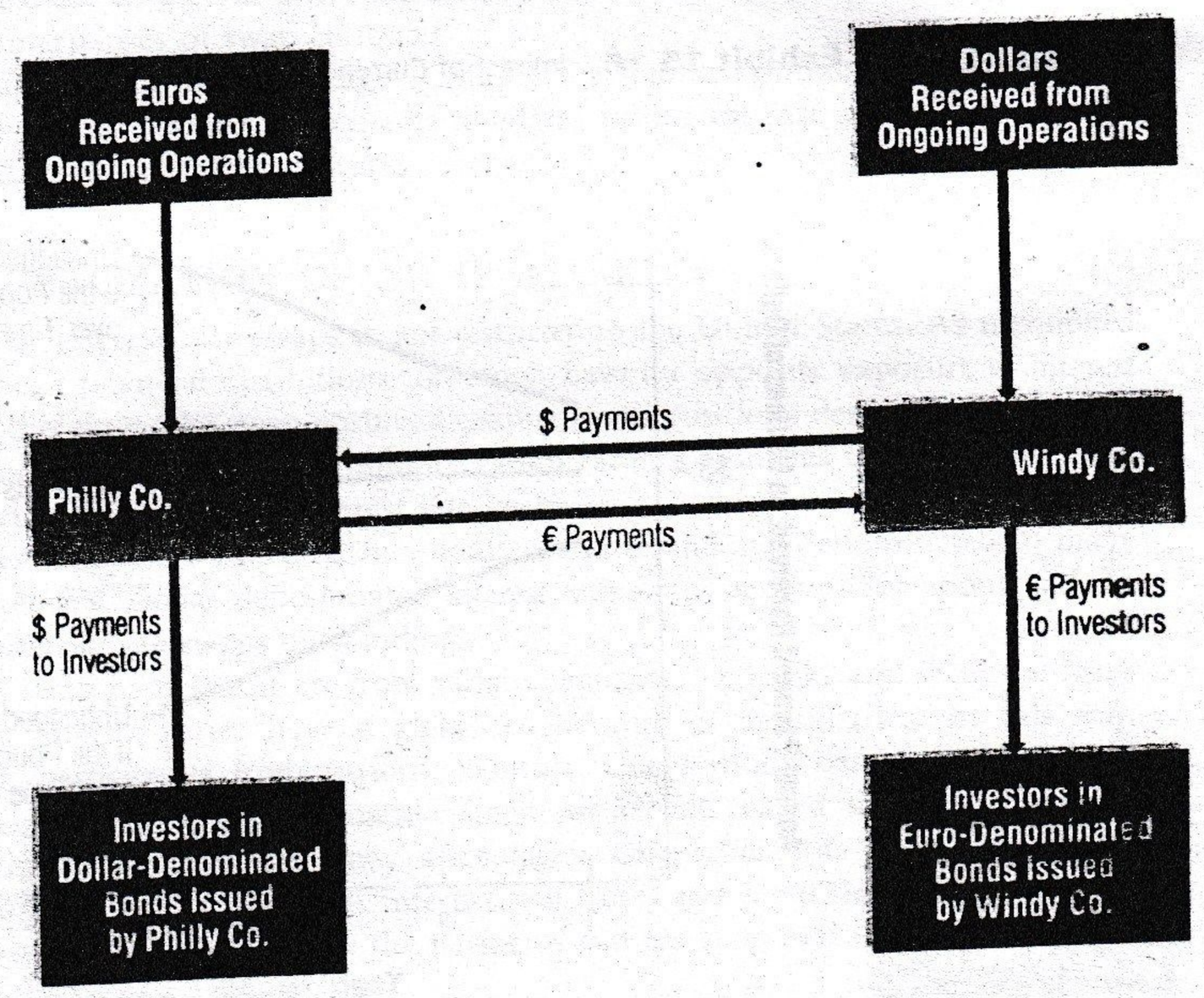
Like interest rate swaps, currency swaps are available in several variations. Some currency swap arrangements allow one of the parties an option to terminate the contract. That party incurs a premium for the option, which is either charged upfront or reflected in the exchange rates specified in the swap arrangement.

Using Currency Swaps to Hedge Bond Payments Although currency swaps are commonly used to hedge payments on international trade, they may also be used in conjunction with bond issues to hedge foreign cash flows.

EXAMPLE

Philly Company, a U.S. firm, wants to issue a bond denominated in euros (the currency now used in several European countries) because it could make payments with euro inflows to be generated from ongoing operations. Philly, however, is not well known to investors who would consider purchasing euro-denominated bonds. Another firm, Windy Company, wants to issue dollar-denominated bonds because its inflow payments are mostly in dollars, but Windy is not well known to the investors who would purchase these bonds. If Philly is known in the dollar-denominated market and Windy is known in the euro-denominated market, the following transactions are appropriate. Philly can issue dollar-denominated bonds while Windy issues euro-denominated bonds. Philly can exchange euros for dollars to make its bond payments, and Windy will receive euros in exchange for dollars to make its bond payments. This currency swap is illustrated in Exhibit 15.17. ●

Exhibit 15.17 Illustration of a Currency Swap



Risk of Currency Swaps The same types of risk that apply to interest rate swaps may also apply to currency swaps. First, there may be basis risk if the firm cannot obtain a currency swap on the currency to which it is exposed and instead uses a related currency. For example, consider a U.S. firm with cash inflows in British pounds that cannot find a counterparty to enact a swap in pounds. The firm may enact a swap in euros because movements (against the dollar) in the euro and the pound are highly correlated. Specifically, the firm will enact a currency swap to exchange euros for dollars. As it receives pounds, it will convert them to euros and then exchange the euros for dollars as specified by the swap arrangement. The exchange rate between pounds and euros is not constant, however, so basis risk exists.

Currency swaps can also be subject to credit risk, which reflects the possibility that the counterparty may default on its obligation. However, the potential loss is somewhat limited because one party can stop exchanging its currency if it no longer receives currency from the counterparty.

A third type of risk is sovereign risk, which reflects the possibility that a country may restrict the convertibility of a particular currency. In this case, a party involved in a swap arrangement may not be able to fulfill its obligation because its government prohibits local currency from being converted to another currency. This scenario is less likely in countries that encourage free trade of goods and securities across borders.

SUMMARY

- Various types of interest rate swaps are used to reduce interest rate risk. Some of the more popular types of interest rate swaps are plain vanilla swaps, forward swaps, callable swaps, putable swaps, extendable swaps, rate-capped swaps, and equity swaps. Each type of swap accommodates a particular need of financial institutions or other firms that are exposed to interest rate risk.
- When engaging in interest rate swaps, the participants can be exposed to basis risk, credit risk, and sovereign risk. Basis risk prevents the interest rate swap from completely eliminating the swap user's exposure to interest rate risk. Credit risk reflects the possibility that the counterparty on a swap agreement may not meet its payment obligations. Sovereign risk reflects the possibility that political conditions could prevent the counterparty in a swap agreement from meeting its payment obligations.
- In addition to the traditional forms of interest rate swaps, three other interest rate derivative instruments are commonly used to hedge interest rate risk: interest rate caps, interest rate floors, and interest rate collars. Interest rate caps offer payments when a specified interest rate index exceeds the interest rate ceiling (cap) and therefore can hedge against rising interest rates. Interest rate floors offer payments when a specified interest rate index falls below a specified interest rate floor; they can be used to hedge against declining interest rates. An interest rate collar involves the purchase of an interest rate cap and the simultaneous sale of an interest rate floor; it is used to hedge against rising interest rates.
- Credit default swaps are commonly purchased by financial institutions to protect against default on specific debt securities that they previously purchased. These swaps are sold by financial institutions that are willing to insure against the securities' default. Some financial institutions with major positions in CDS contracts experienced financial problems during the credit crisis in 2008 and were unable to cover their obligations. The credit crisis was intensified by the uncertainty surrounding potential losses of financial institutions that had positions in credit default swaps.
- The interest rate swap market has become globalized in the sense that financial institutions from various countries participate. Interest rate swaps are available in a variety of currencies.

POINT COUNTER-POINT

Should Financial Institutions Engage in Interest Rate Swaps for Speculative Purposes?

Point Yes. They have expertise in forecasting future interest rate movements and can generate gains for their shareholders by taking speculative positions.

Counter-Point No. They should use their main business to generate gains for their shareholders. They should serve as intermediaries for swap transactions only in order to generate transaction fees or should take a position only if it is to hedge their exposure to interest rate risk.

Who Is Correct? Use the Internet to learn more about this issue and then formulate your own opinion.

QUESTIONS AND APPLICATIONS

1. Hedging with Interest Rate Swaps Bowling Green Savings & Loan uses short-term deposits to fund fixed-rate mortgages. Explain how Bowling Green can use interest rate swaps to hedge its interest rate risk.

2. Decision to Hedge with Interest Rate Swaps Explain the types of cash flow characteristics that would cause a firm to hedge interest rate risk by swapping floating-rate payments for fixed payments. Why would some firms avoid the use of interest rate swaps even when they are highly exposed to interest rate risk?

3. Role of Securities Firms in Swap Market Describe the possible roles of securities firms in the swap market.

4. Hedging with Swaps Chelsea Finance Company receives floating inflow payments from its provision of floating-rate loans. Its outflow payments are fixed because of its recent issuance of long-term bonds. Chelsea is concerned that interest rates will decline in the future. Yet, it does not want to hedge its interest rate risk because it believes interest rates may increase. Recommend a solution to Chelsea's dilemma.

5. Basis Risk Comiskey Savings provides fixed-rate mortgages of various maturities, depending on what customers want. It obtains most of its funds from issuing certificates of deposit with maturities ranging from one month to five years. Comiskey has decided to engage in a fixed-for-floating swap to hedge its interest rate risk. Is Comiskey exposed to basis risk?

6. Fixed-for-Floating Swaps Shea Savings negotiates a fixed-for-floating swap with a reputable firm in South America that has an exceptional credit rating. Shea is very confident that there will not be a default on inflow payments because of the very low credit risk of the South American firm. Do you agree? Explain.

7. Fixed-for-Floating Swaps North Pier Company entered into a two-year swap agreement, which would provide fixed-rate payments for floating-rate payments. Over the next two years, interest rates declined. Based on these conditions, did North Pier Company benefit from the swap?

8. Equity Swap Explain how an equity swap could allow Marathon Insurance Company to capitalize on expectations of a strong stock market performance over the next year without altering its existing portfolio mix of stocks and bonds.

9. Swap Network Explain how the failure of a large commercial bank could cause a worldwide swap credit crisis.

10. Currency Swaps Markus Company purchases supplies from France once a year. Would Markus be favorably affected if it establishes a currency swap arrangement and the dollar strengthens? What if it establishes a currency swap arrangement and the dollar weakens?

11. Basis Risk Explain basis risk as it relates to a currency swap.

12. Sovereign Risk Give an example of how sovereign risk is related to currency swaps.

13. Use of Interest Rate Swaps Explain why some companies that issue bonds engage in interest rate swaps in financial markets. Why do they not simply issue bonds that require the type of payments (fixed or variable) that they prefer to make?

14. Use of Currency Swaps Explain why some companies that issue bonds engage in currency swaps. Why do they not simply issue bonds in the currency that they would prefer to use for making payments?

Advanced Questions

15. Rate-Capped Swaps Bull and Finch Company wants a fixed-for-floating swap. It expects interest rates to rise far above the fixed rate that it would pay and to remain very high until the swap maturity date. Should it consider negotiating for a rate-capped swap with the cap set at 2 percentage points above the fixed rate? Explain.

16. Forward Swaps Rider Company negotiates a forward swap, to begin two years from now, in which it will swap fixed payments for floating-rate payments. What will be the effect on Rider if interest rates rise substantially over the next two years? That is, would Rider be better off using this forward swap than if it had simply waited two years before negotiating the swap? Explain.

17. Swap Options Explain the advantage of a swap option to a financial institution that wants to swap fixed payments for floating payments.

18. Callable Swaps Back Bay Insurance Company negotiated a callable swap involving fixed payments in exchange for floating payments. Assume that interest rates decline consistently up until the swap maturity date. Do you think Back Bay might terminate the swap prior to maturity? Explain.

19. Credit Default Swaps Credit default swaps were once viewed as a great innovation for making mortgage markets more stable. Recently, however, the swaps have been criticized for making the credit crisis worse. Why?

20. Credit Default Swap Prices Explain why the failure of Lehman Brothers caused prices on credit default swap contracts to increase.

21. Reform of CDS Contracts Explain how the Financial Reform Act of 2010 attempted to reduce the risk in the financial system resulting from the use of credit default swaps.

Interpreting Financial News

Interpret the following comments made by Wall Street analysts and portfolio managers.

a. "The swaps market is another Wall Street–developed house of cards."

b. "As a dealer in interest rate swaps, our bank takes various steps to limit our exposure."

c. "The regulation of commercial banks, securities firms, and other financial institutions that participate in the swaps market could create a regulatory war."

Managing in Financial Markets

Assessing the Effects of an Interest Rate Collar As a manager of a commercial bank, you just purchased a three-year interest rate collar with LIBOR as the interest rate index. The interest rate cap specifies a fee of 2 percent of notional principal (valued at $100 million) and an interest rate ceiling of 9 percent. The interest rate floor specifies a fee of 3 percent of the $100 million notional principal and an interest rate floor of 7 percent. Assume that LIBOR is expected to be 6 percent, 10 percent, and 11 percent (respectively) at the end of each of the next three years.

a. Determine the net fees paid, and also determine the expected net payments to be received as a result of purchasing the interest rate collar.

b. Assuming you are very confident that interest rates will rise, should you consider purchasing a callable swap instead of the collar? Explain.

c. Explain the conditions under which your purchase of an interest rate collar could backfire.

PROBLEMS

1. Vanilla Swaps Cleveland Insurance Company has just negotiated a three-year plain vanilla swap in which it will exchange fixed payments of 8 percent for floating payments of LIBOR plus 1 percent. The notional principal is $50 million. LIBOR is expected to be 7 percent, 9 percent, and 10 percent (respectively) at the end of each of the next three years.

a. Determine the net dollar amount to be received (or paid) by Cleveland each year.

b. Determine the dollar amount to be received (or paid) by the counterparty on this interest rate swap each year based on the assumed forecasts of LIBOR.

2. Interest Rate Caps Northbrook Bank purchases a four-year cap for a fee of 3 percent of notional

principal valued at $100 million, with an interest rate ceiling of 9 percent and LIBOR as the index representing the market interest rate. Assume that LIBOR is expected to be 8 percent, 10 percent, 12 percent, and 13 percent (respectively) at the end of each of the next four years.

a. Determine the initial fee paid, and also determine the expected payments to be received by Northbrook if LIBOR moves as forecasted.

b. Determine the dollar amount to be received (or paid) by the seller of the interest rate cap based on the assumed forecasts of LIBOR.

3. Interest Rate Floors Iowa City Bank purchases a three-year interest rate floor for a fee of 2 percent of notional principal valued at $80 million, with an interest rate floor of 6 percent and LIBOR representing the interest rate index. The bank expects LIBOR to be 6 percent, 5 percent, and 4 percent (respectively) at the end of each of the next three years.

a. Determine the initial fee paid, and also determine the expected payments to be received by Iowa City if LIBOR moves as forecasted.

b. Determine the dollar amounts to be received (or paid) by the seller of the interest rate floor based on the assumed forecasts of LIBOR.

FLOW OF FUNDS EXERCISE

Hedging with Interest Rate Derivatives

Recall that if the economy continues to be strong, Carson Company may need to increase its production capacity by about 50 percent over the next few years to satisfy demand. It would need financing to expand and accommodate the increase in production. Recall that the yield curve is currently upward sloping. Also recall that Carson is concerned about a possible slowing of the economy because of potential Fed actions to reduce inflation. Carson currently relies mostly on commercial loans with floating interest rates for its debt financing. It has contacted Blazo Bank about the use of interest rate derivatives to hedge the risk.

a. How could Carson use interest rate swaps to reduce the exposure of its cost of debt to interest rate movements?

b. What is a possible disadvantage of Carson using the interest rate swap hedge as opposed to no hedge?

c. How could Carson use an interest rate cap to reduce the exposure of its cost of debt to interest rate movements?

d. What is a possible disadvantage of Carson using the interest cap hedge as opposed to no hedge? Explain the trade-off between using an interest rate swap versus an interest rate cap.

INTERNET/EXCEL EXERCISES

1. Go to www.economagic.com/fedbog.htm and review the recent annualized rate for a short-term security (such as the 1-year Treasury rate) versus a long-term security (such as the 10-year Treasury rate). Based on this information, do you think that the market expects interest rates to rise over time? Explain.

2. Assume that you need long-term funds and can borrow at the short-term Treasury rate. Based on the existing interest rates, would you consider engaging in a swap of a floating rate in exchange for a fixed rate? Explain.

WSJ EXERCISE

Impact of Interest Rates on a Swap Arrangement

Use a recent issue of the *Wall Street Journal* to determine how short-term interest rates have changed over the last year (assess the Treasury yield for a three-month maturity based on the yield curve shown for

today versus the yield curve shown for a year ago). The three-month Treasury bill rate at the present time and one year ago are quoted in the Money & Investing section of the *Journal*. Explain whether the interest rate movement would have had a favorable impact on a firm that initiated a fixed-for-floating swap agreement one year ago.

Online Articles with Real-World Examples

Find a recent practical article available online that describes a real-world example regarding a specific financial institution or financial market that reinforces one or more concepts covered in this chapter.

If your class has an online component, your professor may ask you to post your summary of the article there and provide a link to the article so that other students can access it. If your class is live, your professor may ask you to summarize your application of the article in class. Your professor may assign specific students to complete this assignment or may allow any students to do the assignment on a volunteer basis.

For recent online articles and real-world examples related to this chapter, consider using the following search terms (be sure to include the prevailing year as a search term to ensure that the online articles are recent):

1. interest rate swap AND hedge
2. interest rate swap AND losses
3. interest rate swap AND financial institutions
4. interest rate swap AND pricing
5. interest rate swap AND risk
6. credit default swap AND losses
7. credit default swap AND crisis
8. credit default swap AND risk
9. credit default swap AND failure
10. credit default swap AND hedge



16 Foreign Exchange Derivative Markets

CHAPTER OBJECTIVES

The specific objectives of this chapter are to:

- provide a background on foreign exchange markets,
- explain how various factors affect exchange rates,
- explain how to forecast exchange rates,
- describe the use of foreign exchange rate derivatives, and
- explain international arbitrage.

In recent years, various derivative instruments have been created to manage or capitalize on exchange rate movements. These so-called **foreign exchange derivatives** (or "forex" derivatives) include forward contracts, currency futures contracts, currency swaps, and currency options. Foreign exchange derivatives account for about half of the daily foreign exchange transaction volume.

The potential benefits from using foreign exchange derivatives are dependent on the expected exchange rate movements. Thus, it is necessary to understand why exchange rates change over time before exploring the use of foreign exchange derivatives.

16-1 Foreign Exchange Markets

As international trade and investing have increased over time, so has the need to exchange currencies. Foreign exchange markets consist of a global telecommunications network among the large commercial banks that serve as financial intermediaries for such exchange. These banks are located in New York, Tokyo, Hong Kong, Singapore, Frankfurt, Zurich, and London. Foreign exchange transactions at these banks have been increasing over time.

At any given time, the price at which banks will buy a currency (bid price) is slightly lower than the price at which they will sell it (ask price). Like markets for other commodities and securities, the market for foreign currencies is more efficient because of financial intermediaries (commercial banks). Otherwise, individual buyers and sellers of currency would be unable to identify counterparties to accommodate their needs.

16-1a Institutional Use of Foreign Exchange Markets

Exhibit 16.1 summarizes how financial institutions utilize the foreign exchange markets and foreign exchange derivatives. The degree of international investment by financial institutions is influenced by potential return, risk, and government regulations. Commercial banks use international lending as their primary form of international investing. Mutual funds, pension funds, and insurance companies purchase foreign securities. In recent years, technology has reduced information costs and other transaction costs associated with purchasing foreign securities, prompting an increase in institutional purchases of foreign securities. Consequently, financial institutions are increasing their use of the foreign exchange markets to exchange currencies. They are also increasing their use of foreign exchange derivatives to hedge their investments in foreign securities.

Exhibit 16.1 Institutional Use of Foreign Exchange Markets

TYPE OF FINANCIAL INSTITUTION	USES OF FOREIGN EXCHANGE MARKETS
Commercial banks	• Serve as financial intermediaries in the foreign exchange market by buying or selling currencies to accommodate customers. • Speculate on foreign currency movements by taking long positions in some currencies and short positions in others. • Provide forward contracts to customers. • Some commercial banks offer currency options to customers; unlike the standardized currency options traded on an exchange, these options can be tailored to a customer's specific needs.
International mutual funds	• Use foreign exchange markets to exchange currencies when reconstructing their portfolios. • Use foreign exchange derivatives to hedge a portion of their exposure.
Brokerage firms and securities firms	• Some brokerage firms and securities firms engage in foreign security transactions for their customers or for their own accounts.
Insurance companies	• Use foreign exchange markets when exchanging currencies for their international operations. • Use foreign exchange markets when purchasing foreign securities for their investment portfolios or when selling foreign securities. • Use foreign exchange derivatives to hedge a portion of their exposure.
Pension funds	• Require foreign exchange of currencies when investing in foreign securities for their stock or bond portfolios. • Use foreign exchange derivatives to hedge a portion of their exposure.

WEB

www.bloomberg.com
Spot rates of currencies and cross-exchange rates among currencies.

16-1b Exchange Rate Quotations

The **direct exchange rate** specifies the value of a currency in U.S. dollars. For example, the Mexican peso may have a value such as $0.10 while the British pound is valued at $2.00. The **indirect exchange rate** specifies the number of units of a currency equal to a U.S. dollar. For the example values given here, the indirect exchange rates are 10 pesos per dollar and 0.50 pounds per dollar. The indirect exchange rate is the reciprocal of the direct exchange rate.

Forward Rate For widely used currencies, **forward rates** are available and are commonly quoted next to the respective spot rates. The forward rates indicate the rate at which a currency can be exchanged in the future. If the forward rate is above the spot rate, it contains a premium. If the forward rate is below the spot rate, it contains a negative premium (also called a discount).

Cross-Exchange Rates Most exchange rate quotation tables express currencies relative to the dollar. In some instances, however, the exchange rate between two nondollar currencies is needed.

EXAMPLE If a Canadian firm needs Mexican pesos to buy Mexican goods, it is concerned about the value of the Mexican peso relative to the Canadian dollar. This type of rate is known as a cross-exchange rate because it reflects the amount of one foreign currency per unit of another foreign currency. Cross-exchange rates can be easily determined with the use of foreign exchange quotations. The general formula follows:

$$\text{Value of 1 unit of Currency A in units of Currency B} = \frac{\text{Value of Currency A in \$}}{\text{Value of Currency B in \$}}$$

If the peso is worth $0.07 and the Canadian dollar (C$) is worth $0.70, the value of the peso in Canadian dollars is calculated as follows:

$$\text{Value of peso in C\$} = \frac{\text{Value of peso in \$}}{\text{Value of C\$ in \$}} = \frac{\$0.07}{\$0.70} = 0.10$$

Thus a Mexican peso is worth C$0.10. The exchange rate can also be expressed as the number of pesos equal to one Canadian dollar. This figure can be computed by taking the reciprocal, 0.70/0.07 = 10, which indicates that a Canadian dollar is worth 10 pesos according to the information provided. ●

16-1c Types of Exchange Rate Systems

From 1944 to 1971, the exchange rate at which one currency could be exchanged for another was maintained by governments within 1 percent of a specified rate. This period was known as the **Bretton Woods era** because the agreement establishing the system was negotiated at the Bretton Woods Conference in Bretton Woods, New Hampshire. The manner by which governments were able to control exchange rates is discussed later in the chapter.

By 1971, the U.S. dollar was clearly overvalued. That is, its value was maintained only by central bank intervention. In 1971, an agreement among all major countries (known as the **Smithsonian Agreement**) allowed for devaluation of the dollar. In addition, the Smithsonian Agreement called for a widening of the boundaries from 1 percent to 2¼ percent around each currency's set value. Governments intervened in the foreign exchange markets whenever exchange rates threatened to wander outside the boundaries.

In 1973, the boundaries were eliminated. Since then, the exchange rates of major currencies have been floating without any government-imposed boundaries. A government may still intervene in the foreign exchange markets to influence the market value of its currency, however. A system with no boundaries and in which exchange rates are market determined but still subject to government intervention is called a **dirty float**. This is to be distinguished from a **freely floating system**, in which the foreign exchange market is totally free from government intervention. Most countries allow their local currency to float but periodically intervene in the foreign exchange market to influence the value of that currency, as will be explained shortly.

Pegged Exchange Rate System Some countries today use a pegged exchange rate system. For example, Hong Kong has tied the value of its currency (the Hong Kong dollar) to the U.S. dollar (HK$78 = $1) since 1983. Thus, its currency's value is fixed relative to the U.S. dollar, which means that its value moves in tandem with the U.S. dollar against other currencies, including other Asian currencies. Thus if the Japanese yen depreciates against the U.S. dollar, it will also depreciate against the Hong Kong dollar.

A country that pegs its currency cannot control its local interest rate because its interest rate must be aligned with the interest rate of the currency to which its currency is tied.

EXAMPLE If Hong Kong lowered its interest rates to stimulate its economy, investors based in Hong Kong would then be enticed to exchange Hong Kong dollars for U.S. dollars and invest in the United States, where interest rates are higher. Since the Hong Kong dollar is tied to the U.S. dollar, the investors would be able to exchange their investment proceeds back to Hong Kong dollars at the end of the investment period without concern for exchange rate risk, which does not exist because the exchange rate is fixed. Therefore, Hong Kong does not attempt to control its own interest rate, which is typically equal to the U.S. interest rate plus a slight premium for risk. As the U.S. interest rate changes, Hong Kong's interest rate changes by about the same degree and in the same direction. ●

The government of Venezuela has historically pegged its currency (the bolivar) to the dollar, although there have been periodic devaluations. The most recent devaluation was on January 9, 2010, when Venezuela devalued the bolivar by 50 percent to 1 bolivar = $0.232.

The new pegged exchange rate reduced the value of the bolivar by 50 percent not only against the dollar but also against all other currencies. For any nondollar currencies that appreciate against the dollar, they appreciate against the bolivar to the same extent.

Because the devaluation of the bolivar makes foreign products expensive for consumers in Venezuela, it encourages more consumption of locally produced products at the expense of foreign products. Furthermore, since the devaluation cut the bolivar's value in half, it increases foreign demand for Venezuela's products. Thus the devaluation is intended to improve Venezuela's economy and reduce its unemployment. However, one possible adverse effect of the devaluation is that the new exchange rate could eliminate foreign competition as foreign products become too expensive. This would allow local producers in Venezuela to increase their prices without much concern about losing customers to foreign firms, which could lead to higher inflation in Venezuela.

China's currency (the yuan) was pegged to the U.S. dollar until 2005. Many U.S. politicians argued that China was maintaining its currency at a level that was too low, which caused an annual U.S. balance of trade deficit of about $200 billion with that country. In July 2005, China implemented a new system that allowed the yuan to float within narrow boundaries based on a set of major currencies. Yet this had only a limited effect on the relative pricing of Chinese and U.S. products, and the balance of trade between the two countries remained large.

16-1d Eurozone Arrangement

In January 1999, the euro replaced the national currencies of eleven European countries; since then, five more countries have converted their home currency to the euro. The countries that now use the euro as their home currency are Austria, Belgium, Cyprus, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Malta, Netherlands, Portugal, Slovakia, Slovenia, and Spain. The countries that participate in the euro make up a region that is referred to as the eurozone. Since all of these countries use the same currency, transactions between them do not require any exchange of currencies. Together, the participating countries produce more than 20 percent of the world's gross domestic product, which exceeds the total production of the United States. In Europe, the countries of Denmark, Norway, Sweden, Switzerland, and the United Kingdom continue to use their own home currency.

The ten countries in Eastern Europe that joined the European Union in 2004 are eligible to participate in the euro if they meet specific economic goals, including a maximum limit on their budget deficit. Some of these countries peg their currency's value to the euro, which allows them to assess how their economy is affected while that value moves in tandem with the euro against other currencies. Under this arrangement, they still have the flexibility to adjust their exchange rate system. If these countries ultimately adopt the euro as their currency, it will be more difficult for them to reverse such decisions.

Eurozone Monetary Policy The European Central Bank (ECB) is responsible for setting monetary policy for all countries in the eurozone. The bank's objective is to maintain price stability (control inflation) in these countries, as it believes that price stability is necessary to achieve economic growth. Since the interest rate on the euro is based on the eurozone monetary policy, all participating countries have the same risk-free interest rate. Thus, eurozone monetary policy simultaneously affects the interest rate in all countries that have adopted the euro as their currency. Although a single monetary policy may allow for more consistent economic conditions across countries, it prevents any individual country from solving local economic problems via its own, unique

monetary policy. However, the member countries can still apply their own fiscal policies (i.e., decisions on taxing and government expenditures).

Eurozone Crisis In the 2010–2012 period, Greece suffered from a weak economy and a large increase in its government budget deficit. Its debt rating was lowered substantially by debt rating agencies, which increased the cost of funds borrowed by the governments. Portugal and Spain also experienced severe financial problems, and the economies of Italy and Ireland weakened as well. Just as integration among economies within the eurozone can allow one country's stimulus to benefit others, a given country's weakness can adversely affect others. Institutional investors moved their investments out of the eurozone and into other regions, which placed downward pressure on the euro's exchange rate.

16-1e Abandoning the Euro

When a government in the eurozone is unable to obtain sufficient credit to cover its budget deficit, it may need to rely on the European Central Bank (ECB) for funds. However, when the ECB provides credit to a country, it imposes austerity conditions that are intended to help the government resolve its budget deficit problems over time. These conditions may include a reduction in government spending and higher tax rates on citizens. Although these conditions may be necessary to correct the budget deficit, they may weaken an economy.

Some critics have argued that a country's government should abandon the euro rather than accept funding from the ECB, because the austerity conditions are too harsh. If a country had its own currency, it may be able to weaken it to a degree that would increase the demand for its exports, and therefore stimulate its economy. However, a weak home currency is not a perfect cure for a country, because it can cause higher inflation. In addition, if the country still planned to repay its debt, it would now have to pay with a new weak home currency, which would require larger payments to cover the existing debt.

Impact of Abandoning the Euro on Eurozone Conditions If a country abandoned use of the euro, it might signal the possible abandonment by other countries that presently participate in the euro. If multinational corporations (MNCs) and large institutional investors outside of the eurozone feared other countries would follow, they may not be willing to invest any more funds in the eurozone, because they might fear the collapse of the euro. This might encourage them to sell their assets in the eurozone now so that they could move their money into their home currency or another currency before the euro weakens.

16-2 Factors Affecting Exchange Rates

As the value of a currency adjusts to changes in demand and supply conditions, it moves toward equilibrium. In equilibrium, there is no excess or deficiency of that currency.

EXAMPLE

A large increase in the U.S. demand for European goods and securities will result in an increased demand for euros. Because the demand for euros will then exceed the supply of euros for sale, the foreign exchange dealers (commercial banks) will experience a shortage of euros and will respond by increasing the quoted price of euros. Hence the euro will appreciate, or increase in value.

Conversely, if European corporations begin to purchase more U.S. goods and European investors purchase more U.S. securities, the opposite forces will occur. There will be an increased sale of euros in exchange for dollars, causing a surplus of euros in the market. The value of the euro will therefore decline until it once again achieves equilibrium. ●

In reality, both the demand for euros and the supply of euros for sale can change simultaneously. The adjustment in the exchange rate will depend on the direction and magnitude of these changes.

A currency's supply and demand are influenced by a variety of factors, including (1) differential inflation rates, (2) differential interest rates, and (3) government (central bank) intervention. These factors will be discussed next.

16-2a Differential Inflation Rates

WEB

http://biz.yahoo.com/topic/currency
Updated news of interest to speculators about specific currencies that are frequently traded in the foreign exchange market.

Begin with an equilibrium situation and consider what will happen to the U.S. demand for euros, and to the supply of euros for sale, if U.S. inflation suddenly becomes much higher than European inflation. The U.S. demand for European goods will increase, reflecting an increased U.S. demand for euros. In addition, the supply of euros to be sold for dollars will decline as the European desire for U.S. goods decreases. Both forces will place upward pressure on the value of the euro.

Under the reverse situation, where European inflation suddenly becomes much higher than U.S. inflation, the U.S. demand for euros will decrease while the supply of euros for sale increases, placing downward pressure on the value of the euro.

A well-known theory about the relationship between inflation and exchange rates, **purchasing power parity (PPP)** suggests that the exchange rate will, on average, change by a percentage that reflects the inflation differential between the two countries of concern.

EXAMPLE

Assume an initial equilibrium situation where the British pound's spot rate is $1.60, U.S. inflation is 3 percent, and British inflation is also 3 percent. If U.S. inflation suddenly increases to 5 percent then, according to PPP, the British pound will appreciate against the dollar by approximately 2 percent. The rationale is that, as a result of the higher U.S. prices, U.S. demand for British goods will increase and thereby place upward pressure on the pound's value. Once the pound appreciates by 2 percent, the purchasing power of U.S. consumers will be the same whether they purchase U.S. goods or British goods. Although the prices of the U.S. goods will have risen by a higher percentage, the British goods will then be just as expensive to U.S. consumers because of the pound's appreciation. Thus a new equilibrium exchange rate results from the change in U.S. inflation. ●

In reality, exchange rates do not always change as suggested by the PPP theory. Other factors that influence exchange rates (discussed next) can distort the PPP relationship. All these factors must be considered when assessing why an exchange rate has changed. Furthermore, forecasts of future exchange rates must account for the potential direction and magnitude of changes in all factors that affect exchange rates.

16-2b Differential Interest Rates

Interest rate movements affect exchange rates by influencing the capital flows between countries. An increase in interest rates may attract foreign investors, especially if the higher interest rates do not reflect an increase in inflationary expectations.

EXAMPLE

Assume U.S. interest rates suddenly become much higher than European interest rates. The demand by U.S. investors for European interest-bearing securities decreases as these securities become less attractive. In addition, the supply of euros to be sold in exchange for dollars expands as European investors increase their purchases of U.S. interest-bearing securities. Both forces put downward pressure on the euro's value.

Conversely, opposite forces play out in the case of higher European than U.S. interest rates, resulting in upward pressure on the euro's value. In general, the currency of the country with a higher increase (or smaller decrease) in interest rates is expected to appreciate, other factors held constant. ●

16-2c Central Bank Intervention

Central banks commonly consider adjusting a currency's value to influence economic conditions. For example, the U.S. central bank may wish to weaken the dollar to increase demand for U.S. exports, which can stimulate the economy. However, a weaker dollar can also cause U.S. inflation by reducing foreign competition (because it raises the price of foreign goods to U.S. consumers). Alternatively, the U.S. central bank may prefer to strengthen the dollar to intensify foreign competition, which can reduce U.S. inflation.

Direct Intervention A country's government can intervene in the foreign exchange market to affect a currency's value. Direct intervention occurs when a country's central bank (such as the Federal Reserve Bank for the United States or the European Central Bank for the eurozone countries) sells some of its currency reserves for a different currency.

EXAMPLE Assume that the Federal Reserve and the European Central Bank desire to strengthen the value of the euro against the dollar. They use dollar reserves to purchase euros in the foreign exchange market. In essence, they dump dollars in the foreign exchange market and thereby increase the demand for euros. ●

However, central bank intervention can be overwhelmed by market forces and so may not always succeed in reversing exchange rate movements. In fact, the efforts of the Fed and the ECB to boost the value of the euro in 2000 were not successful. Nevertheless, central bank intervention may significantly affect the foreign exchange markets in two ways. First, it may slow the momentum of adverse exchange rate movements. Second, commercial banks and other corporations may reassess their foreign exchange strategies if they believe the central banks will continue to intervene.

Indirect Intervention The Fed can affect the dollar's value indirectly by influencing the factors that determine its value. For example, the Fed can attempt to lower interest rates by increasing the U.S. money supply (assuming that inflationary expectations are not affected). Lower U.S. interest rates tend to discourage foreign investors from investing in U.S. securities, thereby putting downward pressure on the value of the dollar. Or, to boost the dollar's value, the Fed can attempt to increase interest rates by reducing the U.S. money supply. Indirect intervention can be an effective means of influencing a currency's value.

When countries experience substantial net outflows of funds (which put severe downward pressure on their currency), they commonly use indirect intervention by raising interest rates to discourage excessive outflows and thus limit the downward pressure on their currency's value. However, this action adversely affects local borrowers (government agencies, corporations, and consumers) and may weaken the economy.

Indirect Intervention during the Peso Crisis In 1994, Mexico experienced a large balance of trade deficit, perhaps because the peso was stronger than it should have been, which encouraged Mexican firms and consumers to buy an excessive amount of imports. By December 1994, there was substantial downward pressure on the peso. On December 20, 1994, Mexico's central bank devalued the peso by about 13 percent. Mexico's stock prices plummeted, as many foreign investors sold their shares and withdrew their funds from Mexico in anticipation of further devaluation in the peso. On December 22, the central bank allowed the peso to float freely; it declined by another 15 percent. This was the beginning of the so-called Mexican peso crisis. The central bank increased interest rates as a form of indirect intervention to discourage foreign investors from withdrawing their investments in Mexico's debt securities. The higher interest rates increased the cost of borrowing for Mexican firms and consumers, thereby slowing economic growth.

Indirect Intervention during the Asian Crisis In the fall of 1997, many Asian countries experienced weak economies and their banks suffered from substantial defaults on loans. Concerned about their investments, investors began to withdraw their funds. Some countries (e.g., Thailand and Malaysia) increased their interest rates as a form of indirect intervention aimed at encouraging investors to leave their funds in Asia. However, the higher interest rates increased the cost to firms that had borrowed funds there, making it more difficult for them to repay their loans. In addition, the high interest rates discouraged new borrowing by firms and weakened the region's economies.

During the Asian crisis, investors also withdrew funds from Brazil and reinvested them in other countries, causing major capital outflows and putting extreme downward pressure on Brazil's currency (the real). At the end of October, the central bank of Brazil responded by doubling its interest rates from about 20 percent to about 40 percent. This action discouraged investors from pulling funds out of Brazil because they could now earn twice the interest from investing in some securities there. Although the bank's action was successful in defending the real, it reduced economic growth because the cost of borrowing funds was too high for many firms.

Indirect Intervention during the Russian Crisis A similar situation occurred in Russia in May 1998. Over the previous four months, the Russian currency (the ruble) had consistently declined and stock market prices had declined by more than 50 percent. Because the lack of confidence in Russia's currency and stocks could cause massive outflows of funds, the Russian central bank attempted to minimize such outflows by tripling interest rates (from about 50 to 150 percent). The ruble was temporarily stabilized, but stock prices continued to decline because investors were concerned that the high interest rates would reduce economic growth.

Indirect Intervention during the Greek Crisis Greece is one of the European countries that uses the euro as its local currency. In the spring of 2010, it experienced weak economic conditions and a large increase in its government budget deficit. Its debt rating was lowered substantially by debt rating agencies to the point where it was paying about 11 percent on its debt, versus 4 percent for other countries in the eurozone. As the government of Greece attempted to cut its spending to correct the budget deficit, the economy weakened. There were even rumors that Greece would abandon the euro as its currency, which could have caused still more uncertainty about the euro and about the future of eurozone country economies. Thus the Greek crisis led to concerns about the eurozone and encouraged speculators to dump euros in favor of dollars or other currencies. In spring 2010, the euro declined by 20 percent.

The ECB responded with a stimulative monetary policy that was intended to keep interest rates low. Although the ECB might well have preferred a more restrictive monetary policy in order to keep inflation low, its policy evidently considered the potential weakening of the eurozone economy due to the Greek crisis. An important lesson from the crisis is how the conditions in one eurozone country can affect every country that uses the same currency.

16-3 Forecasting Exchange Rates

Market participants who use foreign exchange derivatives tend to take positions based on their expectations of future exchange rates. For example, multinational corporations take positions in foreign exchange derivatives to hedge their future cash flows denominated in foreign currencies, especially when they expect that they will be adversely affected by that exposure. Portfolio managers of financial institutions may take positions in foreign exchange derivatives to hedge their exposure if they anticipate a decline in the value of

the currency denominating their stocks. Speculators may take positions in foreign exchange derivatives to benefit from the expectation that specific currencies will strengthen. Thus, the initial task is to develop a forecast of specific exchange rates. There are various techniques for forecasting, but no specific technique stands out because most have had limited success in forecasting future exchange rates. Most forecasting techniques can be classified as one of the following types:

- Technical forecasting
- Fundamental forecasting
- Market-based forecasting
- Mixed forecasting

WEB

www.oanda.com
Historical exchange rates.

16-3a Technical Forecasting

Technical forecasting involves the use of historical exchange rate data to predict future values. For example, the fact that a given currency has increased in value over four consecutive days may provide an indication of how the currency will move tomorrow. Sometimes a more complex statistical analysis is applied. For example, a computer program can be developed to detect particular historical trends.

There are also several **time-series models** that examine moving averages and thus allow a forecaster to identify patterns, such as currency tending to decline in value after a rise in moving average over three consecutive periods. Normally, consultants who use such a method will not disclose their particular rule for forecasting. If they did, potential clients might apply the rules themselves rather than pay for the consultant's advice.

Technical forecasting of exchange rates is similar to technical forecasting of stock prices. If the pattern of currency values over time appears to be random, then technical forecasting is not appropriate. Unless historical trends in exchange rate movements can be identified, examination of past movements will not be useful for indicating future movements.

16-3b Fundamental Forecasting

Fundamental forecasting is based on fundamental relationships between economic variables and exchange rates. Given current values of these variables along with their historical impact on a currency's value, corporations can develop exchange rate projections. For example, high inflation in a given country can lead to depreciation in its currency. Of course, all other factors that may influence exchange rates should also be considered.

A forecast may arise simply from a subjective assessment of the degree to which general movements in economic variables in one country are expected to affect exchange rates. From a statistical perspective, a forecast would be based on quantitatively measured impacts of factors on exchange rates.

16-3c Market-Based Forecasting

Market-based forecasting, or the process of developing forecasts from market indicators, is usually based on either the spot rate or the forward rate.

Use of the Spot Rate To clarify why the spot rate can serve as a market-based forecast, assume the British pound is expected to appreciate against the dollar in the very near future. This will encourage speculators to buy the pound with U.S. dollars today in anticipation of its appreciation, and these purchases could immediately force the pound's value upward. Conversely, if the pound is expected to depreciate against the dollar, speculators will sell off pounds now and hope to purchase them back at a lower price after they decline in value. Such action could force the pound to depreciate immediately. Thus, the current

value of the pound should reflect the expectation of that currency's value in the very near future. In other words, corporations can use the spot rate to forecast because it represents the market's expectation of the spot rate in the near future.

Use of the Forward Rate The forward rate can also serve as a forecast of the future spot rate. The reason is that speculators would take positions if there were a large discrepancy between the forward rate and expectations of the future spot rate.

EXAMPLE The 30-day forward rate of the British pound is $1.40, and the general expectation of speculators is that the future spot rate of the pound will be $1.45 in 30 days. Since speculators expect the future spot rate to be $1.45 and since the prevailing forward rate is $1.40, they might buy pounds 30 days forward at $1.40 and then sell them when received (in 30 days) at the spot rate existing then. If their forecast is correct, they will earn $0.05 ($1.45 - $1.40) per pound. If a large number of speculators implement this strategy, the substantial forward purchases of pounds will cause the forward rate to increase until this speculative demand stops. Perhaps this speculative demand will terminate when the forward rate reaches $1.45, since at this rate no profits could be expected from implementing the strategy. Thus, the forward rate should move toward the market's general expectation of the future spot rate. In this sense, the forward rate serves as a market-based forecast because it reflects the market's expectation of the spot rate at the end of the forward horizon (in this example, 30 days from now). ●

16-3d Mixed Forecasting

Because no single forecasting technique has been found to be consistently superior to the others, some MNCs use a combination of forecasting techniques. This method is referred to as **mixed forecasting**. Various forecasts for a particular currency value are developed using several forecasting techniques. Each of the techniques used is assigned a weight, and the techniques believed to be more reliable are assigned higher weights. Thus the MNC's forecast of the currency will be a weighted average of the various forecasts developed.

16-4 Foreign Exchange Derivatives

Foreign exchange derivatives can be used to speculate on future exchange rate movements or to hedge anticipated cash inflows or outflows in a given foreign currency. As foreign securities markets have become more accessible, institutional investors have increased their international investments, which in turn has increased their exposure to exchange rate risk. Some institutional investors use foreign exchange derivatives to hedge their exposure. The most popular foreign exchange derivatives are forward contracts, currency futures contracts, currency swaps, and currency options contracts.

16-4a Forward Contracts

Forward contracts are contracts, typically negotiated with a commercial bank, that allow the purchase or sale of a specified amount of a particular foreign currency at a specified exchange rate (the forward rate) on a specified future date. A **forward market** facilitates the trading of forward contracts. This market is not in one physical place; it is a telecommunications network through which large commercial banks match participants who wish to buy a currency forward with other participants who wish to sell a currency forward.

Many of the commercial banks that offer foreign exchange on a spot basis also offer forward transactions for widely traded currencies. By enabling a firm to lock in the price to be paid for a foreign currency, forward purchases or sales can hedge the firm's risk that the currency's value may change over time.

EXAMPLE St. Louis Insurance Company plans to invest about $20 million in Mexican stocks two months from now. Because the Mexican stocks are denominated in pesos, the amount of stock that can be purchased depends on the peso's value at the time of the purchase. If St. Louis Insurance Company is concerned that the peso will appreciate by the time of the purchase, it can buy pesos forward to lock in the exchange rate. ●

A corporation receiving payments denominated in a particular foreign currency in the future can lock in the price at which the currency can be sold by selling that currency forward.

EXAMPLE The pension fund manager of Gonzaga, Inc., plans to liquidate the fund's holdings of British stocks in six months but anticipates that the British pound will depreciate by that time. The pension fund manager can insulate the future transaction from exchange rate risk by negotiating a forward contract to sell British pounds six months forward. In this way, the British pounds received when the stocks are liquidated can be converted to dollars at the exchange rate specified in the forward contract. ●

Some commercial banks accommodate requests by firms to buy or sell currencies forward. If a bank's forward purchase and sale contracts do not even out for a given date, the bank is exposed to exchange rate risk.

EXAMPLE Nebraska Bank has contracts committed to selling C$100 million and purchasing C$150 million 90 days from now. It will receive C$50 million more than it sells. An increase in the Canadian dollar's value 90 days from now will be advantageous, but if the Canadian dollar depreciates then the bank will be adversely affected by its exposure to the exchange rate risk. ●

Estimating the Forward Premium The forward rate of a currency will sometimes exceed the existing spot rate, thereby exhibiting a premium. At other times, it will be below the spot rate, exhibiting a discount. Forward contracts are sometimes referred to in terms of their percentage premium or discount rather than their actual rate. For example, assume that the spot rate (S) of the Canadian dollar is $0.70 while the 180-day (n = 180) forward rate (FR) is $0.71. The forward rate premium (p) would be

$$p = \frac{FR - S}{S} \times \frac{360}{n}$$

$$= \frac{\$0.71 - \$0.70}{\$0.70} \times \frac{360}{180}$$

$$= 2.86\%$$

This premium simply reflects the percentage by which the forward rate exceeds the spot rate on an annualized basis.

WEB

www.cmegroup.com
Review this website for information on currency futures contracts.

16-4b Currency Futures Contracts

An alternative to the forward contract is a currency futures contract, which is a standardized contract that specifies an amount of a particular currency to be exchanged on a specified date and at a specified exchange rate. A firm can purchase a futures contract to hedge payables in a foreign currency by locking in the price at which it could purchase that specific currency at a particular point in time. To hedge receivables denominated in a foreign currency, it could sell futures and thereby lock in the price at which it could sell that currency. A futures contract represents a standard number of units. Currency futures contracts also have specific maturity (or "settlement") dates from which the firm must choose.

Futures contracts are standardized, whereas forward contracts can specify whatever amount and maturity date the firm desires. Forward contracts have this flexibility because they are negotiated with commercial banks rather than on a trading floor.

16-4c Currency Swaps

A currency swap is an agreement that allows one currency to be periodically swapped for another at specified exchange rates. It essentially represents a series of forward contracts. Commercial banks facilitate currency swaps by serving as the intermediary that links two parties with opposite needs. Alternatively, commercial banks may be willing to take the position counter to that desired by a particular party. In such a case, they expose themselves to exchange rate risk unless the position they have assumed will offset existing exposure.

16-4d Currency Options Contracts

WEB

www.cmegroup.com
Review this website to find quotes on currency options contracts.

Another foreign exchange derivative used for hedging is the currency option. Its primary advantage over forward and futures contracts is in stipulating that the parties have the right but not the *obligation* to purchase or sell a particular currency at a specified price within a given period.

A currency call option provides the right to purchase a particular currency at a specified price (called the *exercise* price) within a specified period. This type of option can be used to hedge future cash payments denominated in a foreign currency. If the spot rate remains below the exercise price, the option will not be exercised because the firm could purchase the foreign currency at a lower cost in the spot market. However, a fee (or a premium) must be paid for options, so there is a cost to hedging with options even if the options are not exercised.

A put option provides the right to sell a particular currency at a specified price (the exercise price) within a specified period. If the spot rate remains above that price, the option will not be exercised because the firm could sell the foreign currency at a higher price in the spot market. But if the spot rate is below the exercise price at the time the foreign currency is received, the firm will exercise its put option.

16-4e Use of Foreign Exchange Derivatives for Hedging

When deciding whether to use forward, futures, or options contracts for hedging, a firm should consider the following characteristics of each contract. First, if the firm requires a tailor-made hedge that cannot be matched by existing futures contracts, a forward contract may be preferred. Otherwise, forward and futures contracts should generate somewhat similar results.

The choice between an obligation type of contract (forward or futures) or an options contract depends on the expected trend of the spot rate. If the currency in which payables are denominated appreciates, the firm will benefit more from a futures or forward contract than from a call option contract. The call option contract requires an up-front fee, but it is a wiser choice when the firm is less certain of a currency's future direction. The call option allows the firm to hedge against possible appreciation and also to ignore the contract, and use the spot market instead, if the currency depreciates. Similarly, put options may be preferred over futures or forward contracts for hedging receivables when future currency movements are especially uncertain, because the firm has the flexibility of letting the options expire if the currencies strengthen.

16-4f Use of Foreign Exchange Derivatives for Speculating

The forward, currency futures, and currency options markets may be used for speculating as well as for hedging. A speculator who expects the Singapore dollar to appreciate could consider any of the following strategies.

1. Purchase Singapore dollars forward; when they are received, sell them in the spot market.
2. Purchase futures contracts on Singapore dollars; when the Singapore dollars are received, sell them in the spot market.
3. Purchase call options on Singapore dollars; at some point before the expiration date, when the spot rate exceeds the exercise price, exercise the call option and then sell the Singapore dollars received in the spot market.

Conversely, a speculator who expects the Singapore dollar to depreciate could consider any of the following strategies.

1. Sell Singapore dollars forward, and then purchase them in the spot market just before fulfilling the forward obligation.
2. Sell futures contracts on Singapore dollars; purchase Singapore dollars in the spot market just before fulfilling the futures obligation.
3. Purchase put options on Singapore dollars; at some point before the expiration date, when the spot rate is less than the exercise price, purchase Singapore dollars in the spot market and then exercise the put option.

Speculating with Currency Futures As an example of speculating with currency futures, consider the following information.

- Spot rate of the British pound is $1.56 per pound.
- Price of a futures contract is $1.57 per pound.
- Expectation of the pound's spot rate on the settlement date of the futures contract is $1.63 per pound.

Given that the future spot rate is expected to be higher than the futures price, you could buy currency futures. You would receive pounds on the settlement date for $1.57. If your expectations are correct, you would then sell the pounds for $0.06 more per unit than you paid for them. The risk of your speculative strategy is that the pound may decline rather than increase in value. If it declines to $1.55 by the settlement date, you would have sold the pounds for $0.02 less per unit than you paid.

To account for uncertainty, speculators may develop a probability distribution for the future spot rate as follows.

FUTURE SPOT RATE OF BRITISH POUND	PROBABILITY
$1.50	10%
1.59	20
1.63	50
1.66	20

This probability distribution suggests that four outcomes are possible. For each possible outcome, the anticipated gain or loss can be determined:

POSSIBLE OUTCOME FOR FUTURE SPOT RATE	PROBABILITY	GAIN OR LOSS PER UNIT
$1.50	10%	–$0.07
1.59	20	0.02
1.63	50	0.06
1.66	20	0.09

This analysis measures the probability and potential magnitude of a loss from the speculative strategy.

Speculating with Currency Options Consider the information from the previous example and assume that a British call option is available with an exercise price of $1.57 and a premium of $0.03 per unit. Recall that your best guess of the future spot rate was $1.63. If your guess is correct, you will earn $0.06 per unit on the difference between what you paid (the exercise price of $1.57) and the price for which you could sell a pound ($1.63). After the premium paid for the option ($0.03 per unit) is deducted, the net gain is $0.03 per unit.

The risk of purchasing this option is that the pound's value might decline over time. If so, you will be unable to exercise the option, and your loss will be the premium paid for it. To assess the risk involved, a probability distribution can be developed. In Exhibit 16.2, the probability distribution from the previous example is applied here. The distribution of net gains from the strategy is shown in the sixth column.

Speculators should always compare the potential gains from currency options and currency futures contracts to determine which type of contract (if any) to trade. It is possible for two speculators to have similar expectations about potential gains from both types of contracts yet to prefer different types of contracts because they have different degrees of risk aversion.

Exhibit 16.2 Estimating Speculative Gains from Options Using a Probability Distribution

(1) POSSIBLE OUTCOME FOR FUTURE SPOT RATE	(2) PROBABILITY	(3) WILL THE OPTION BE EXERCISED BASED ON THIS OUTCOME?	(4) GAIN PER UNIT FROM EXERCISING OPTION	(5) PREMIUM PAID PER UNIT FOR THE OPTION	(6) NET GAIN OR LOSS PER UNIT
$1.50	10%	No	—	$.03	–$.03
1.59	20	Yes	$.02	.03	–.01
1.63	50	Yes	.06	.03	.03
1.66	20	Yes	.09	.03	.06

16-5 International Arbitrage

Exchange rates and exchange rate derivatives are market determined. If they become misaligned, various forms of arbitrage can occur, forcing realignment. Common types of international arbitrage are explained next.

16-5a Locational Arbitrage

Locational arbitrage is the act of capitalizing on a discrepancy between the spot exchange rate at two different locations by purchasing the currency where it is priced low and selling it where it is priced high.

EXAMPLE

The exchange rates of the European euro quoted by two banks differ, as shown in Exhibit 16.3. The ask quote is higher than the bid quote to reflect the transaction costs charged by each bank. Because Baltimore Bank is asking $1.046 for euros and Sacramento Bank is willing to pay (bid) $1.050 for euros, an institution could execute locational arbitrage. That is, it could achieve a risk-free return without tying funds up for any length of time by buying euros at one location (Baltimore Bank) and simultaneously selling them at the other location (Sacramento Bank). ●

As locational arbitrage is executed, Baltimore Bank will begin to raise its ask price on euros in response to the strong demand. In addition, Sacramento Bank will begin to lower its bid price in response to the excess supply of euros it has recently received. Once Baltimore's ask price is at least as high as Sacramento's bid price, locational arbitrage will no longer be possible. Because some financial institutions (particularly the foreign exchange departments of commercial banks) watch for locational arbitrage opportunities, any discrepancy in exchange rates among locations is quickly eliminated.

16-5b Triangular Arbitrage

If the quoted cross-exchange rate between two foreign currencies is not aligned with the two corresponding exchange rates, there is a discrepancy in the exchange rate quotations. Under this condition, investors can engage in **triangular arbitrage**, which involves buying or selling the currency that is subject to a mispriced cross-exchange rate.

EXAMPLE

If the spot rate is $0.07 for the Mexican peso and $0.70 for the Canadian dollar, the cross-exchange rate should be C$1 = 10 pesos (computed as $0.70/$0.07). Assume that the Canadian dollar/peso exchange rate is quoted as C$1 = 10.3 pesos. In this case, the quote for the Canadian dollar is higher than it should be. An investor could benefit by using U.S. dollars to buy Canadian dollars, using those Canadian dollars to buy pesos, and then using the pesos to buy U.S. dollars. These three transactions would be executed at about the same time, before the exchange rates change. With $1,000, you could buy C$1,428.57 (computed as 1,000 ÷ 0.70), convert those Canadian dollars into 14,714 pesos (computed as 1,428.57 × 10.3), and then convert the pesos into $1,030 (computed as 14,714 × 0.07). Thus, you would have a gain of $30. Of course, the gain would be larger if you engaged in triangular arbitrage using a larger amount of money. ●

Exhibit 16.3 Bank Quotes Used for Locational Arbitrage Example

	BID RATE ON EUROS	ASK RATE ON EUROS
Sacramento Bank	$1.050	$1.056
Baltimore Bank	$1.042	$1.046

Whenever there is a discrepancy in exchange rates, financial institutions with large amounts of money will engage in triangular arbitrage, causing the quoted exchange rates to quickly adjust. The arbitrage transaction of using U.S. dollars to buy Canadian dollars will cause the Canadian dollar to appreciate with respect to the U.S. dollar. The arbitrage transaction of using Canadian dollars to buy pesos will cause the Canadian dollar to depreciate against the peso, and the transaction of using pesos to buy U.S. dollars will cause the peso to depreciate against the U.S. dollar. Once the cross-exchange rate adjusts to its appropriate level, triangular arbitrage will no longer be feasible. The rates may adjust within a matter of seconds in response to the market forces. Quoted cross-exchange rates normally do not reflect a discrepancy because, if they did, financial institutions would capitalize on the discrepancy until the exchange rates were realigned.

16-5c Covered Interest Arbitrage

The coexistence of international money markets and forward markets forces a special relationship, between a forward rate premium and the interest rate differential of two countries, that is known as **interest rate parity**. This relationship also has implications for currency futures contracts, since they are normally priced like forward contracts.

According the interest rate parity, the premium on the forward rate can be determined as

$$p = \frac{(1 + i_h)}{(1 + i_f)} - 1$$

where

p = **forward premium of foreign currency**
i_h = **home country interest rate**
i_f = **foreign interest rate**

EXAMPLE

The spot rate of the New Zealand dollar is $0.50, the one-year U.S. interest rate is 9 percent, and the one-year New Zealand interest rate is 6 percent. Under conditions of interest rate parity, the forward premium of the New Zealand dollar will be

$$p = \frac{(1 + 9\%)}{(1 + 6\%)} - 1$$
$$\simeq 2.8\%$$

This means that the forward rate of the New Zealand dollar will be about $0.514, reflecting a 2.8 percent premium above the spot rate. ●

Examining the equation for interest rate parity reveals that if the interest rate is lower in the foreign country than in the home country, the forward rate of the foreign currency will exhibit a premium. In the opposite situation, the forward rate will exhibit a discount.

Interest rate parity suggests that the forward rate premium (or discount) should be about equal to the differential in interest rates between the countries of concern. If this relationship does not hold, market forces should occur that will restore it. The act of capitalizing on the discrepancy between the forward rate premium and the interest rate differential is called **covered interest arbitrage.**

EXAMPLE

Both the spot rate and the one-year forward rate of the Canadian dollar are $0.80. The Canadian interest rate is 10 percent and the U.S. interest rate is 8 percent. Hence U.S. investors can take

advantage of the higher Canadian interest rate, without being exposed to exchange rate risk, by executing covered interest arbitrage. Specifically, they will exchange U.S. dollars for Canadian dollars and invest at the rate of 10 percent. They will simultaneously sell Canadian dollars one year forward. Because they are able to purchase and sell Canadian dollars for the same price, their return is the 10 percent interest earned on their investment. ●

As the U.S. investors demand Canadian dollars in the spot market while selling Canadian dollars forward, they place upward pressure on the spot rate and downward pressure on the one-year forward rate of the Canadian dollar. Thus, the Canadian dollar's forward rate will exhibit a discount. Once the discount becomes large enough, the interest rate advantage in Canada will be offset. In other words, what U.S. investors gain on the higher Canadian interest rate is offset by having to buy Canadian dollars at a higher (spot) rate than the selling (forward) rate. Then covered interest arbitrage will no longer generate a return that is any higher for U.S. investors than an alternative investment in the United States. Once the forward discount (or premium) offsets the interest rate differential in this manner, interest rate parity exists.

The interest rate parity equation determines the forward discount that the Canadian dollar must exhibit in order to offset the interest rate differential:

$$p = \frac{(1 + i_h)}{(1 + i_f)} - 1$$

$$= \frac{(1 + 8\%)}{(1 + 10\%)} - 1$$

$$\simeq -1.82\%$$

If the forward rate is lower than the spot rate by 1.82 percent, the interest rate is offset and covered interest arbitrage would yield a return to U.S. investors similar to the U.S. interest rate.

The existence of interest rate parity prevents investors from earning higher returns from covered interest arbitrage than can be earned in the United States. Nevertheless, international investing may still be feasible if the investing firm does not simultaneously cover in the forward market. Of course, failure to do so usually exposes the firm to exchange rate risk; if the currency denominating the investment depreciates over the investment horizon, the return on the investment is reduced.

SUMMARY

- Exchange rate systems vary in the degree to which a country's central bank controls its currency's exchange rate. Many countries allow their currency to float yet periodically engage in intervention to control the exchange rate. Some countries use a pegged exchange rate system in which the currency's value is pegged to the U.S. dollar or to another currency. Several European countries have adopted the euro as their currency; a single monetary policy is implemented in those countries.
- Exchange rates are influenced by differential inflation rates, differential interest rates, and central bank intervention. There is upward pressure on a foreign currency's value when its home country has relatively low inflation or relatively high interest rates. Central banks can place upward pressure on a currency by purchasing that currency in the foreign exchange markets (by exchanging other currencies held in reserve for tha currency). Alternatively, they can place downward pressure on a currency by selling that currency in the foreign exchange markets in exchange for other currencies.
- Exchange rates can be forecasted using technical, fundamental, and market-based methods. Each method has its own advantages and limitations.

- Foreign exchange derivatives include forward contracts, currency futures contracts, currency swaps, and currency options contracts. Forward contracts can be purchased to hedge future payables or be sold to hedge future receivables in a foreign currency. Currency futures contracts can be used in a manner similar to forward contracts to hedge payables or receivables in a foreign currency. Currency swaps can be used to lock in the exchange rate of a foreign currency to be received or purchased in the future. Currency call (put) options can be purchased to hedge future payables (receivables) in a foreign currency. Currency options offer more flexibility than the other foreign exchange derivatives, but a premium must be paid for them.

  Foreign exchange derivatives can also be used to speculate on expected exchange rate movements. When speculators expect a foreign currency to appreciate, they can lock in the exchange rate at which they may purchase that currency by purchasing forward contracts, futures contracts, or call options on that currency. When speculators expect a currency to depreciate, they can lock in the exchange rate at which they may sell that currency by selling forward contracts or futures contracts on that currency. They could also purchase put options on that currency.
- International arbitrage ensures that foreign exchange market prices are set properly. If exchange rates vary among the banks that serve the foreign exchange market, locational arbitrage will be possible. Foreign exchange market participants will purchase a currency at the bank with a low quote and sell it to another bank where the quote is higher. If a quoted cross-exchange rate is misaligned with the corresponding exchange rates, triangular arbitrage will be possible. This involves buying or selling the currency that is subject to the mispriced exchange rate. If the interest rate differential is not offset by the forward rate premium (as suggested by interest rate parity), covered interest arbitrage will be possible. This involves investing in a foreign currency and simultaneously selling the currency forward. Arbitrage will occur until interest rate parity is restored.

Point Counter-Point

Do Financial Institutions Need to Consider Foreign Exchange Market Conditions When Making Domestic Security Market Decisions?

Point No. If there is no exchange of currencies, there is no need to monitor the foreign exchange market.

Counter-Point Yes. Foreign exchange market conditions can affect an economy or an industry, and therefore affect the valuation of securities. In addition, the valuation of a firm can be affected by currency movements because of its international business.

Who Is Correct? Use the Internet to learn more about this issue and then formulate your own opinion on this issue.

Questions and Applications

1. **Exchange Rate Systems** Explain the exchange rate system that existed during the 1950s and 1960s. How did the Smithsonian Agreement in 1971 revise it? How does today's exchange rate system differ?

2. **Dirty Float** Explain the difference between a freely floating system and a dirty float. Which type is more representative of the U.S. system?

3. **Impact of Quotas** Assume that European countries impose a quota on goods imported from the United States and that the United States does not plan to retaliate. How could this affect the value of the euro? Explain.

4. **Impact of Capital Flows** Assume that stocks in the United Kingdom become very attractive to U.S. investors. How could this affect the value of the British pound? Explain.

5. **Impact of Inflation** Assume that Mexico suddenly experiences high and unexpected inflation.

How could this affect the value of the Mexican peso according to purchasing power parity (PPP) theory?

6. Impact of Economic Conditions Assume that Switzerland has a very strong economy, putting upward pressure on both inflation and interest rates. Explain how these conditions could put pressure on the value of the Swiss franc, and determine whether the franc's value will rise or fall.

7. Central Bank Intervention The Bank of Japan desires to decrease the value of the Japanese yen against the U.S. dollar. How could it use direct intervention to do this?

8. Conditions for Speculation Explain the conditions under which a speculator would like to invest in a foreign currency today even when it has no use for that currency in the future.

9. Risk from Speculating Seattle Bank just took speculative positions by borrowing Canadian dollars and converting the funds to invest in Australian dollars. Explain a possible future scenario that could adversely affect the bank's performance.

10. Impact of a Weak Dollar How does a weak dollar affect U.S. inflation? Explain.

11. Speculating with Foreign Exchange Derivatives Explain how U.S. speculators could use foreign exchange derivatives to speculate on the expected appreciation of the Japanese yen.

Advanced Questions

12. Interaction of Capital Flows and Yield Curve Assume a horizontal yield curve exists. How do you think the yield curve would be affected if foreign investors in short-term securities and long-term securities suddenly anticipate that the value of the dollar will strengthen? (You may find it helpful to refer back to the discussion of the yield curve in Chapter 3.)

13. How the Euro's Value May Respond to Prevailing Conditions Consider the prevailing conditions for inflation (including oil prices), the economy, interest rates, and any other factors that could affect exchange rates. Based on these conditions, do you think the euro's value will likely appreciate or depreciate against the dollar for the remainder of this semester? Offer some logic to support your answer. Which factor do you think will have the biggest impact on the euro's exchange rate?

14. Obtaining Credit from the European Central Bank What are the consequences to a government in the eurozone when it obtains credit from the ECB?

15. Impact of Abandoning the Euro on Eurozone Conditions. Explain the possible signal that would be transmitted to the market if a country abandoned use of the euro.

Interpreting Financial News

Interpret the following statements made by Wall Street analysts and portfolio managers.

a. "Our use of currency futures has completely changed our risk–return profile."

b. "Our use of currency options resulted in an upgrade in our credit rating."

c. "Our strategy of using forward contracts to hedge backfired on us."

Managing in Financial Markets

Using Forex Derivatives for Hedging You are the manager of a stock portfolio for a financial institution, and about 20 percent of the stock portfolio that you manage is in British stocks. You expect the British stock market to perform well over the next year, and you plan to sell the stocks one year from now (and will convert the British pounds received to dollars at that time). However, you are concerned that the British pound may depreciate against the dollar over the next year.

a. Explain how you could use a forward contract to hedge the exchange rate risk associated with your position in British stocks.

b. If interest rate parity holds, does this limit the effectiveness of a forward contract as a hedge?

c. Explain how you could use an options contract to hedge the exchange rate risk associated with your position in stocks.

d. Assume that, although you are concerned about the potential decline in the pound's value, you also believe that the pound could appreciate against the dollar over the next year. You would like to benefit from the potential appreciation but also wish to hedge against the possible depreciation. Should you use a forward contract or options contracts to hedge your position? Explain.

PROBLEMS

1. Currency Futures Use the following information to determine the probability distribution of per unit gains from selling Mexican peso futures.

- Spot rate of the peso is $0.10.
- Price of peso futures is $0.102 per unit.
- Your expectation of the peso spot rate at maturity of the futures contract is:

POSSIBLE OUTCOME FOR FUTURE SPOT RATE	PROBABILITY
$0.090	10%
0.095	70
0.110	20

2. Currency Call Options Use the following information to determine the probability distribution of net gains per unit from purchasing a call option on British pounds.

- Spot rate of the British pound is $1.45.
- Premium on the British pound option is $0.04 per unit.
- Exercise price of a British pound option is $1.46.
- Your expectation of the British pound spot rate prior to the expiration of the option is:

POSSIBLE OUTCOME FOR FUTURE SPOT RATE	PROBABILITY
$1.48	30%
1.49	40
1.52	30

3. Locational Arbitrage Assume the following exchange rate quotes on British pounds:

	BID	ASK
Orleans Bank	$1.46	$1.47
Kansas Bank	1.48	1.49

Explain how locational arbitrage would occur. Also explain why this arbitrage will realign the exchange rates.

4. Covered Interest Arbitrage Assume the following information:

- British pound spot rate = $1.58
- British pound one-year forward rate = $1.58
- British one-year interest rate = 11 percent
- U.S. one-year interest rate = 9 percent

Explain how U.S. investors could use covered interest arbitrage to lock in a higher yield than 9 percent. What would be their yield? Explain how the spot and forward rates of the pound would change as covered interest arbitrage occurs.

5. Covered Interest Arbitrage Assume the following information:

- Mexican one-year interest rate = 15 percent
- U.S. one-year interest rate = 11 percent

If interest rate parity exists, what would be the forward premium or discount on the Mexican peso's forward rate? Would covered interest arbitrage be more profitable to U.S. investors than investing at home? Explain.

FLOW OF FUNDS EXERCISE

Hedging with Foreign Exchange Derivatives

Carson Company expects that it will receive a large order from the government of Spain. If the order occurs, Carson will be paid about 3 million euros. Since all of its expenses are in dollars, Carson would like to hedge this position. Carson has contacted a bank with brokerage subsidiaries that can help it hedge with foreign exchange derivatives.

a. How could Carson use currency futures to hedge its position?

b. What is the risk of hedging with currency futures?

c. How could Carson use currency options to hedge its position?

d. Explain the advantage and disadvantage to Carson of using currency options instead of currency futures.

INTERNET/EXCEL EXERCISES

Use the website www.oanda.com to assess exchange rates.

1. What is the most recent value of the Australian dollar in terms of U.S. dollars? For large transactions, how many British pounds does a U.S. dollar buy?

2. Review the pound's value over the past year. Offer a possible explanation for the recent movements in the pound's value.

3. What is the most recent value of the Hong Kong dollar in terms of U.S. dollars? Do you notice anything unusual about this value over time? What could explain an exchange rate trend such as this?

WSJ EXERCISE

Assessing Exchange Rate Movements

Use a recent issue of the *Wall Street Journal* to determine how a particular currency's value has changed against the dollar since the beginning of the year. The "Currencies" table lists the percentage change in many currencies since the beginning of the year.

ONLINE ARTICLES WITH REAL-WORLD EXAMPLES

Find a recent practical article available online that describes a real-world example regarding a specific financial institution or financial market that reinforces one or more concepts covered in this chapter. If your class has an online component, your professor may ask you to post your summary of the article there and provide a link to the article so that other students can access it.

If your class is live, your professor may ask you to summarize your application of the article in class. Your professor may assign specific students to complete this assignment or may allow any students to do the assignment on a volunteer basis.

For recent online articles and real-world examples related to this chapter, consider using the following search terms (be sure to include the prevailing year as a search term to ensure that the online articles are recent):

1. foreign exchange AND institutional investors
2. inflation AND exchange rate
3. interest rate AND exchange rate
4. central bank intervention
5. foreign exchange controls
6. currency AND forecasting
7. currency AND forward contract
8. forward contract AND hedge
9. currency futures AND speculate
10. currency options AND hedge

APPENDIX 16

Currency Option Pricing

Understanding what drives the premiums paid for currency options makes it easier to recognize the various factors that must be monitored when anticipating future movements in currency option premiums. Because 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 lower bound of a call option premium (C) is either zero or the difference between the underlying spot exchange rate (S) and the exercise price (X), whichever is greater:

$$C \geq \max(0, S - X)$$

This floor is enforced by arbitrage restrictions. For example, assume that the premium on a British pound call option is \$0.01 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 \$0.01 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. These actions would generate an immediate profit of \$0.01 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 either zero or the difference between the exercise price and the underlying spot exchange rate, whichever is greater:

$$P \geq \max(0, X - S)$$

This floor is also enforced by arbitrage restrictions. For example, assume that the premium on a British pound put option is \$0.02 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 \$0.02 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 to yield a profit of \$0.01 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 the spot exchange rate, S:

$$C \leq S$$

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 were exercised, one could pay them off using the currency purchased earlier. The arbitrage profit in this example would be the difference between the amount received when selling (which is 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:

$$P \leq X$$

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

Option premiums lie within these boundaries because the boundaries are enforced by arbitrage.

Application of Pricing Models

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 (e.g., the exercise price and time to maturity) and about the currency (e.g., 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 (1983) is

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

where

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

C = price of the currency call option
S = underlying spot exchange rate
X = exercise price
R_f = U.S. riskless rate of interest
R_f^* = foreign riskless rate of interest
σ = instantaneous standard deviation of the return on a holding of foreign currency
T = time to option maturity expressed as a fraction of 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_f^*) 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, the percentage change of exchange rates (like that of stocks) is assumed to follow a diffusion process with constant mean and variance.

The model developed by Biger and Hull is sometimes referred to as the European model because it does not account for early exercise.* Unlike American currency options, European currency options do not allow for early exercise (i.e., before the expiration date). The extra flexibility of American currency options should entail a higher premium 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 such options, the European model is commonly applied because it can be just as accurate for American as for European currency options.

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 C of a European call option, the premium P for a European put option on the same currency and with the same exercise price X can be derived from put–call parity as follows:

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

where R_f is the riskless rate of interest, R_f^* is the foreign rate of interest, and T is the option's time to maturity expressed as a fraction of the year.

If the actual put option premium is *less* than suggested by the put–call parity equation just shown, arbitrage is possible. Specifically, one could (1) buy the put option, (2) sell the call option, and (3) buy the underlying currency. The purchases would be financed with the proceeds from selling the call option and from borrowing at the rate R_f. Meanwhile, the foreign currency that was purchased can be deposited to earn the foreign rate R_f^*. Regardless of the path of the currency's exchange rate movement over the option's lifetime, the arbitrage will result in a profit. First, if the exchange rate is equal to the exercise price so 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 would expire, the foreign currency would be converted in the spot market to dollars, and this amount will exceed the amount required to repay the loan and the amount of the loss on the call option. Third, if the foreign currency depreciates and thus is below the exercise price, the amount received from selling 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 suggested by put–call parity, arbitrage would again be possible. The arbitrage strategy would be the reverse of that just described for the case when the actual put option premium is less than suggested by put–call parity. Again, the arbitrage would eventually force an adjustment in option

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

premiums so that put–call parity is no longer violated. Note, however, that the arbitrage applicable when there is a violation of put–call parity on American currency options differs slightly from the arbitrage applicable to European currency options. Even so, the concept still holds that the premium of a currency put option is determined by the premium of a call option on the same currency and with the same exercise price.

PART 5 INTEGRATIVE PROBLEM

Choosing among Derivative Securities

This problem requires an understanding of futures contracts (Chapter 13), options markets (Chapter 14), interest rate swap markets (Chapter 15), and foreign exchange derivative markets (Chapter 16). It also requires an understanding of how economic conditions affect interest rates and security prices.

Assume that the United States has just experienced a mild recession. As a result, interest rates have declined to their lowest levels in a decade. The U.S. interest rates appear to be influenced more by changes in the demand for funds than by changes in the supply of U.S. savings, because the savings rate does not change much regardless of economic conditions. The yield curve is currently flat. The federal budget deficit has been reduced lately and is not expected to rise substantially.

The federal government recently decided to reduce personal tax rates significantly for all tax brackets and also to reduce corporate tax rates. The U.S. dollar has just recently weakened. Economies of other countries were somewhat stagnant but have improved in the past quarter. Your assignment is to recommend how various financial institutions should respond to the preceding information.

Questions

1. A savings institution holds 50 percent of its assets as long-term, fixed-rate mortgages. Virtually all of its funds are in the form of short-term deposits. Which of the following strategies would be most appropriate for this institution?

   - Use a fixed-for-floating swap.
   - Use a swap of floating payments for fixed payments.
   - Use a put option on interest rate futures contracts.
   - Remain unhedged.

   Defend your recommendation.

2. An insurance company maintains a large portfolio of U.S. stocks. Which of the following would be more appropriate?

   - Sell stock index futures contracts.
   - Remain unhedged.

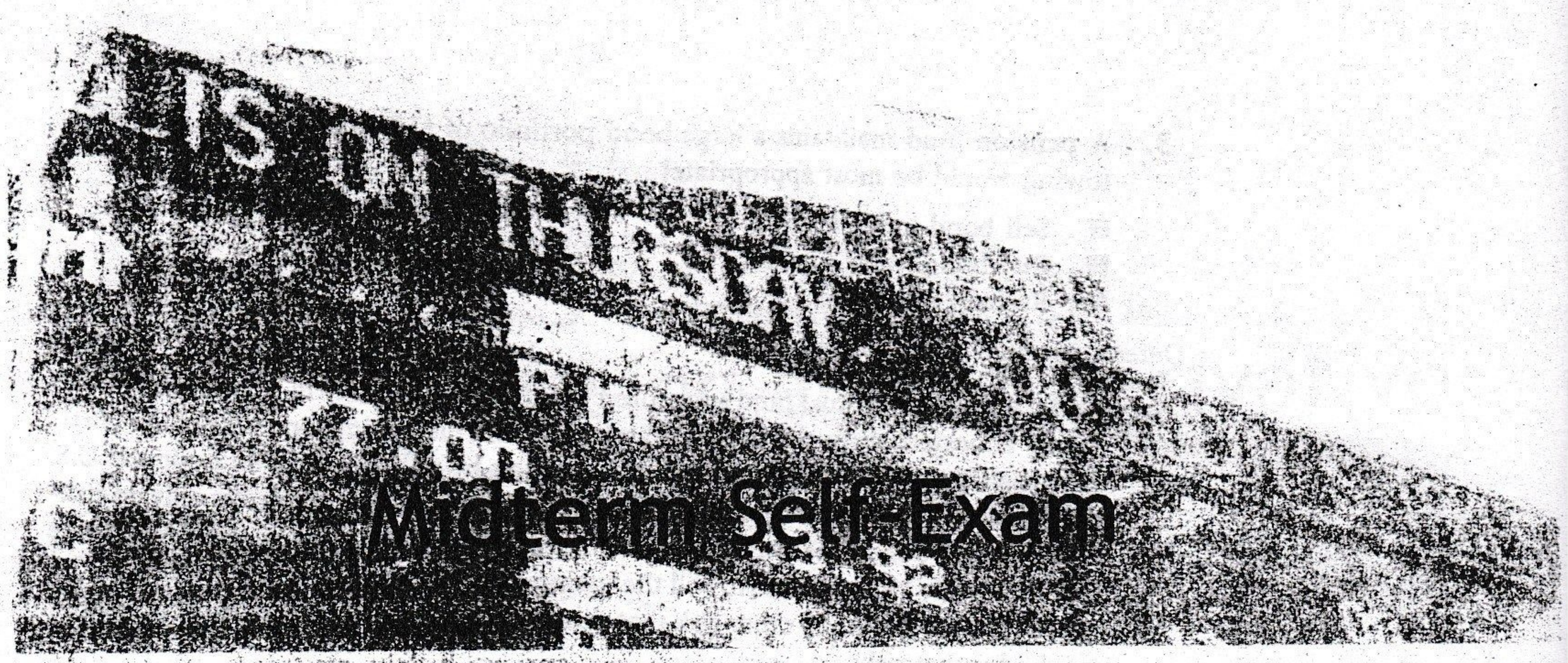
   Defend your recommendation.

3. A pension fund maintains a large bond portfolio of U.S. bonds. Which of the following would be most appropriate?

   - Sell bond index futures.
   - Buy bond index futures.
   - Remain unhedged.

Defend your recommendation.

4. An international mutual fund sponsored by a U.S. securities firm consists of bonds evenly allocated across the United States and the United Kingdom. One of the portfolio managers has decided to hedge all the assets by selling futures on a popular U.S. bond index. The manager has stated that, because the fund concentrates only on risk-free Treasury bonds, the only concern is interest rate risk. Assuming that interest rate risk is the only risk of concern, will the manager's hedging strategy be effective? Why or why not? Is there any other risk that deserves to be considered? If so, how would you hedge that risk?



Midterm Review

You have just completed all of the chapters focused on the financial markets. Here is a brief summary of some of the key points in those chapters.

Chapter 1 provides an overview of the types of financial markets, the securities that are traded within those markets, and the financial institutions that serve those markets. Chapter 2 explains how general interest rate levels are driven by factors that affect the demand for loanable funds (such as inflation and economic growth) and the supply of loanable funds (such as the Fed's monetary policy). Chapter 3 explains how interest rates vary among securities in response to differences in credit risk, liquidity, tax status, and term to maturity. Chapter 4 describes the Fed's monetary policy, and Chapter 5 explains how the Fed's policy adjusts the supply of loanable funds to affect interest rates and economic conditions.

Chapter 6 explains how money market securities serve investors whose primary need is liquidity rather than high returns. Chapters 7 through 12 describe the characteristics, pricing, and risk of capital market securities. In particular, Chapters 7 through 9 focus on long-term debt securities and explain the sensitivity of long-term debt's market values to interest rate movements. Chapter 10 describes how stocks are placed and how institutional investors attempt to ensure that managers of publicly traded companies make decisions that maximize the stock's value. Chapter 11 shows how the value of a stock is influenced by the factors that influence the firm's future cash flows or risk. Chapter 12 describes how stocks are traded and how the trading is regulated. Because money market securities, long-term debt securities, and stocks have different characteristics, they serve different investors. In addition, the sensitivity of their prices to various factors differs among securities. Investors are therefore able to allocate their investments in securities in a way that reflects their specific return and risk preferences.

Chapter 13 explains how interest rate futures contracts can be sold to speculate on expectations of rising rates and also how such contracts can be sold to speculate on expectations of declining interest rates. In addition, this chapter explains how interest rate futures can be sold to hedge the interest rate risk of portfolios containing long-term debt securities and how stock index futures contracts can be used to hedge the market risk of stock portfolios. Chapter 14 explains how call (put) options can be used to speculate on expectations of rising (falling) stock prices. It also explains how put options on stock indexes can be used to hedge stock portfolios and how put options on bond

RFMI-11th - 32 R

index futures can be used to hedge long-term debt security portfolios. Chapter 15 explains how interest rate swaps can be used to speculate on expectations of rising or declining interest rates, and Chapter 16 explains how foreign exchange markets are used to facilitate the trading of international securities.

This exam does not cover all of the concepts that have been presented up to this point. It is simply intended to allow you to test yourself on a general overview of key concepts. Simulate taking an exam by answering all of the questions *without* using your book and your notes. The answer key is provided just after the exam. If you have any wrong answers, you should reread the related material and then redo any exam questions that you had wrong.

This exam may not match the level of rigor in your course. Your instructor may provide specific information about how this Midterm Self-Exam relates to the coverage and rigor of the midterm exam in your course.

Midterm Self-Exam

1. Explain the meaning of asymmetric information and how it can have an impact on trading in the stock market.

2. In the last year, the one-year risk-free interest rate increased from 3 to 7 percent.

a. What is a likely reason for the large increase in the risk-free rate?

b. In the last year, the 10-year risk-free rate declined from 7 to 6 percent. How can you reconcile the change in the short-term interest rate with the change in the long-term interest rate? According to expectations theory, what does the shift in the yield curve imply about future interest rates?

3. The prevailing yield on a B-rated corporate bond is 7 percent. Explain how the yield offered on new B-rated bonds could be affected if economic conditions deteriorate. There are two forces that deserve consideration.

4. Consider the components that determine the prevailing yield of a highly rated corporate bond, such as the risk-free rate, the default risk premium, and the liquidity premium. The yield offered on a corporate bond in the secondary market changes over time. Which component do you think is typically the main source of changes over time in the yield offered on a highly rated corporate bond? Explain.

5. Recently, economic conditions have weakened. Although consumer prices have not increased in the last year, oil prices have risen by 20 percent in the last month. The Fed wants to show its dedication to controlling inflation and therefore decides to restrict the money supply and increase the target federal funds rate by 0.5 percent.

a. If you were on the FOMC, would you support the Fed's decision? Explain.

b. Explain how prices of money market securities would change in response to this policy. Why might bond prices be more sensitive than money market securities to this change in the Fed's policy? Why might bond prices be less sensitive than money market securities to changes in the Fed's policy?

6. Assume that the Fed decided to reduce the federal funds rate by 0.5 percent today and that this decision was not anticipated by the financial markets.

a. Why might this change in monetary policy affect the yields paid by corporations when they issue corporate bonds?

b. Why might the change in monetary policy have no effect on the yields paid by corporations when they issue corporate bonds?

7. Why do bond market participants pay close attention to the fiscal policy decisions of the U.S. government?

8. A Treasury bond's coupon and principal payments are guaranteed. Does this mean that the value of the Treasury bond is almost constant over time? Explain.

9. Offer a logical explanation for why higher expected inflation could affect the yield on new, 30-year, fixed-rate mortgages. Why are secondary price movements of fixed-rate mortgages correlated with price movements of corporate bonds?

10. Assume that the Fed uses monetary policy to reduce the target federal funds rate, and assume that the market does not anticipate this reduction. Use the CAPM framework to explain why this policy could enhance the prices of stocks.

11. Assume that the standard deviation of a stock's monthly returns is 4 percent and that the expected return of the stock over the next month is zero. Use the value-at-risk method to estimate the maximum expected loss for a month based on a 95 percent confidence level.

12. Based on what you learned in the chapters on the bond markets and stock markets, are these markets complements or substitutes from an issuer's perspective? From an investor's perspective?

13. Explain why a publicly traded firm's ability to place stock in a secondary offering is dependent on the stock's liquidity in the secondary market.

14. Why would a publicly traded firm go private? Why might the Sarbanes-Oxley Act encourage some publicly traded firms to go private?

15. Why does the market for corporate control affect stock valuations? Offer a reason why the market for corporate control will not always force corporate managers to serve in the best interests of shareholders.

16. Charleston Investment Company just purchased Renfro stock for $50. It engages in a covered call strategy whereby it sells call options on Renfro stock. A call option on Renfro stock is available with an exercise price of $52, a one-year expiration date, and a premium of $2. Assume that the buyers of the call option will exercise the option on the expiration date if it is feasible to do so. Charleston will sell the stock at the end of one year even if the option is not exercised. Determine the net profit per share for Charleston based on the following possible prices for Renfro stock at the end of one year:

a. $45

b. $49

c. $50

d. $53

e. $55

17. a. Compare the purchase of stock index futures versus index options. Why might institutional investors use futures to hedge their stock portfolios in some periods and use options for that same purpose in other periods?

b. For hedging a stock portfolio, explain the trade-off involved when purchasing a put option with an exercise price that is at the money versus deep out of the money.

18. Assume that interest rate parity holds. Assume U.S. investors plan to invest in a government security denominated in a foreign currency.

a. If the security has a higher interest rate than the U.S. interest rate, will the forward rate of the currency exhibit a discount? Explain.

b. If the investors engage in covered interest arbitrage, will they achieve a return that is higher than, lower than, or the same as the foreign interest rate? Explain.

c. If the investors engage in covered interest arbitrage, will they achieve a return that is higher than, lower than, or the same as the U.S. interest rate? Explain.

Answers to Midterm Self-Exam

1. Asymmetric information occurs because managers of publicly traded firms have more information about their firms than do investors, who do not work at the firm. Consequently, the valuation of firms by investors is limited because there may be private information about the firms that they do not have. This can result in improper pricing of stocks and a wide dispersion among investors regarding the proper valuation of stocks.

2. a. Common reasons for higher interest rates include a stronger economy, higher inflation, and a more restrictive monetary policy.

b. The yield curve had a steep upward slope one year ago. Now the yield curve has a slight downward slope. According to expectations theory, the prevailing yield curve indicates that interest rates are expected to decline in the future.

3. If deteriorating economic conditions cause a decline in the demand for loanable funds, the risk-free interest rate will decline. However, the risk premium should increase because the chance of default by the issuer of the bonds will be higher as a result of the weaker economy.

4. Changes in the risk-free rate can have a major impact on the yield offered on a corporate bond. The default risk premium and liquidity premium may change, but normally they have less impact on the yield offered over time.

5. a. No, because the policy will not necessarily have any impact on oil prices. However, the policy will slow economic growth and the economy is already weak.

b. Prices of money market securities will decline in response to the Fed's policy change because the interest rate and hence the required rate of return on short-term securities will increase, so the present value of their cash flows will be reduced. When the Fed reduces the money supply in order to increase the federal funds rate, this shift could also affect long-term interest rates. If so, the required rate of return on bonds will change and, in response, long-term bond prices will decline. If the Fed's policy has no effect on long-term interest rates, the prices of long-term bonds should not change. In this case, bond prices are less sensitive than are money market security prices to the Fed's policy.

6. a. The short-term and long-term markets for debt securities are partially integrated. Therefore, when the Fed increases the money supply in order to reduce the federal funds rate, some of the increased funds in the financial system may be used to invest in bonds. The additional funds supplied to the bond market can reduce the rate that corporations must pay when they borrow by issuing bonds.

b. Sometimes, when the Fed increases the money supply, most of the additional funds are channeled into short-term debt securities rather than long-term debt securities. In this case, there may be no effect on the yields offered on new corporate bonds.

17. a. Institutional investors may prefer to hedge with stock index futures when they are less confident about stock market conditions, because they forgo the potential gain if market conditions are favorable. Index options may be more desirable when investors want to hedge but also believe there is a reasonable chance that market conditions will be favorable. They must pay a premium for such flexibility.

b. When hedging against market declines, a lower premium is paid when purchasing a stock index option that is deep out of the money. However, the hedge is less effective because the exercise price is low; hence the stock portfolio is hedged against only large losses. Purchasing a stock index put option at the money to hedge against market declines will insulate a stock portfolio even if losses are small, but the premium paid for this type of option is high.

18. a. Yes, based on the interest rate parity formula.

b. Lower, because there is a discount on the forward rate.

c. The same, based on interest rate parity.


LISBON
RIO
69
36.56