



## Using Derivatives to Manage Interest Rate Risk

For the past 20 years, financial institutions have made increasing use of derivatives in portfolio management. Market participants use these contracts to hedge other positions that expose them to risk or speculate on anticipated price moves. In many cases, banks can replicate on-balance sheet transactions entirely with off-balance sheet contracts so they can serve as substitute positions.

The term derivative in financial markets refers to any instrument or contract that derives its value from another underlying asset, instrument, or contract. The fastest-growing derivatives are interest rate swaps, caps, floors, and financial futures, particularly those that are LIBOR based. On several recent occasions derivatives have been in the spotlight because of their assumed role when global stock markets fell sharply and when Enron and other firms reported substantive losses from derivatives positions. In these instances, regulators, politicians, and the media expressed concern over their use and growth. When used prudently, however, derivatives represent a cost-effective means to manage risk.

This chapter explains the features of financial futures, forward rate agreements (FRAs) and basic interest rate swaps and how they are used by financial institutions. It describes several applications that show each tool's strengths and weaknesses. The applications focus on Eurodollar futures, London Interbank Offer Rate (LIBOR) based FRAs, swaps, and interest rate caps and floors because they are the fastest-growing contracts used by financial institutions. The concepts, however, apply to all related contracts.

Imagine a situation where your bank only makes floating-rate loans. One of your best business customers approaches you and wants to borrow, but only on a fixed-rate basis. Do you try to change the customer's mind, somehow convincing the firm to borrow at the prevailing prime rate plus a spread? Or can you make a fixed-rate loan and effectively convert it to a floating-rate loan? If you do the latter, everyone wins: the customer gets fixed-rate financing and the bank gets a floating-rate loan.

**B**anking professionals constantly search for new products and opportunities to improve bank operating performance. Financial futures, FRAs, interest rate swaps, and interest rate caps and floors are four types of derivatives that commercial banks actively use to help manage interest rate risk. Institutions use these contracts primarily to hedge asset yields or the interest cost of liabilities, adjust maturities by creating synthetic liabilities, protect the value of assets from changing rates, and adjust the overall sensitivity of earnings or market value of stockholders' equity.

This chapter extends the discussion of interest rate risk in Chapters 5 and 6 by describing four general tools that banks use to manage interest rate risk. The first, financial futures contracts, have been available since 1975 but have only recently gained acceptability for their own use among banks. The second, forward rate agreements, were introduced in 1983 to provide an explicit forward market for interest rates. The third, interest rate swaps, were introduced in 1980 and are now used actively by large and small banking organizations. The final contracts are options on interest rates labeled interest rate caps and floors.

Volume has increased to such levels that bank regulators are concerned that industry usage has grown beyond regulators' ability to understand and monitor the risks banks assume. Banks can use each of these tools to complement existing strategies involving matching or consciously mismatching rate-sensitive assets and liabilities and corresponding durations, thereby altering the sensitivity of earnings and economic value of equity (EVE). Remember that the responsibility of bank managers is to manage, not totally eliminate, risk.

## CHARACTERISTICS OF FINANCIAL FUTURES

**Financial futures contracts** represent a commitment between two parties—a buyer and a seller—on the price and quantity of a standardized financial asset or index. The contracts are transferable because they are traded on organized exchanges called **futures markets**, and all contracts are subject to a daily settlement procedure. Buyers of futures contracts, referred to as *long* futures, agree to pay the underlying futures price, while sellers of futures contracts, referred to as *short* futures, agree to receive the futures price or deliver the underlying asset as stipulated in the contract. Thus, buyers and sellers can eliminate their commitments by taking the opposite position prior to contract expiration by selling and buying the futures contract, or by making or taking delivery of the underlying asset.

Because futures prices fluctuate daily, buyers and sellers find that their initial position changes in value daily. When futures prices increase, buyers gain at the expense of sellers, while sellers gain at the expense of buyers when futures prices fall. At the end of each day participants must pay any decrease in value or, alternatively, they receive any increase in value as part of the daily settlement procedure. When the contract expires, they pay or receive the final change in value (cash settlement) or exchange the actual underlying asset (physical delivery) for cash at the initial negotiated price. The process essentially fixes the underlying instrument's price at the time of the trade for the future date designated by the contract. The underlying financial asset may be a short-term money market instrument, a long-term bond, units of a foreign currency, precious metals, or even common stock indexes. When the underlying asset is an interest-bearing security, the contracts are labeled **interest rate futures**. Futures contracts are traded daily prior to the formal expiration/delivery date, with the price changing as market conditions dictate. These unique features stand out when compared with cash market transactions and forward contracts.

**Cash or spot** market transactions represent the exchange of any asset between two parties who agree on the asset's characteristics and price, where the buyer tenders payment and takes possession of the asset when the price is set. Most transactions take this form. A **forward contract** involves two parties agreeing on an asset's characteristics, quantity, and price, but defers the actual exchange until a specified future date. Forward contracts do not necessarily involve standardized assets. Both parties to the transaction must simply agree on the asset's quality and price. Because the underlying asset is not standardized, the parties deal directly with each other and there is little opportunity to walk away from the commitment prior to delivery. Finally, once the terms of a forward contract are set, the parties do not make any payments or deliveries until the specified forward transactions date. However, forward contracts often do require collateral or a letter of credit to guarantee performance.

### TYPES OF FUTURES TRADERS

Futures contracts are traded on exchanges, the most prominent of which in the United States are the Chicago Board of Trade (CBT) and the Chicago Mercantile Exchange (CME). Many of the contracts traded on U.S. exchanges are also traded outside the United States, such that participants have the opportunity to trade 24 hours a day. Continuous trading is important, given that many trades are implemented to reduce risk and participants need immediate access to hedge instruments.

Futures traders have various motivations and thus follow different strategies. Traders operating on the floor of an exchange are classified as either **commission brokers**, who execute trades for other parties, or **locals**, who trade for their own account. As the name suggests, commission brokers generate income by charging commissions for each trade and thus take no price risk. Locals are individuals who try to profit by buying contracts at prices less than what they sell the contracts for. As such, locals assume considerable price risk in their transactions but add liquidity to the markets.

Traders are further classified by the strategies they pursue. At one extreme is the **speculator**, who takes a position with the objective of making a profit. Speculators try to guess the direction that prices will move and time their trades to sell at higher prices than the purchase price. Locals are thus speculators. Speculators are often distinguished by the length of time they hold their positions. A **scalper** tries to time price movements over very short time intervals and takes positions that remain outstanding for just minutes. A **day trader** similarly tries to profit from short-term price movements during trading hours in any day, but offsets the initial position before market closing so that no position remains outstanding overnight. Finally, a **position trader** is a speculator who holds a position for a longer period in anticipation of a more significant, longer-term market move.

At the other extreme is the hedger. A **hedger** has an existing or anticipated position in the cash market and trades futures contracts (or some other contract) to reduce the risk associated with uncertain changes in value of the cash position. The cash position might involve owning or buying an asset, borrowing by issuing an interest-bearing liability, or a bank's overall earnings and MVE-sensitivity profile. With hedging, the trader takes a position in the futures market whose value varies in the opposite direction as the value of the cash market position. Risk is reduced because gains or losses on the futures position at least partially offset gains or losses on the cash position. The essential difference between a speculator and hedger is the objective of the trader. A speculator wants to profit on trades while a hedger wants to reduce risk.

Traders may also be classified as **spreaders** or **arbitrageurs**. Both spreaders and arbitrageurs are speculators who take relatively low-risk positions. For example, a **futures spreader** may simultaneously buy a futures contract and sell a related futures contract, trying to profit on anticipated movements in the price difference between the contracts. The position is generally low risk because the prices of both contracts typically move in the same direction. Losses on one contract are thus at least partially offset by gains on the other. An **arbitrageur** tries to profit by identifying the same asset that is being traded at two different prices in different markets at the same time. The arbitrageur buys the asset at the lower price and simultaneously sells it at the higher price, profiting on the difference. Arbitrage transactions are thus lower risk and serve to bring prices back in line, in the sense that the same asset should trade at the same price in all markets.

### THE MECHANICS OF FUTURES TRADING

Futures contracts are traded on formal, organized exchanges that serve as clearinghouses. Trading occurs in an *open outcry* auction market. Each party to a futures transaction effectively trades with exchange members who, in turn, guarantee the performance of all participants. In practice, a buyer and seller are found for each transaction, but the exchange assumes all obligations at the end of each trading day, forcing members to settle their net positions. This procedure enables any trader to offset an initial position by taking the opposite position any time prior to the futures contract's delivery date. For example, a buyer of a Eurodollar futures contract with delivery in 60 days can offset the position by selling the same contract one week later when 53 days remain to delivery. This liquidity is not found with forward contracts. It results from trading standardized assets through an exchange, where each party does not have to renegotiate with the same party who initiated the contract.

Futures contracts entail cash-flow obligations for buyers and sellers during the entire time the position is outstanding. At initiation of a futures position, traders must post a cash deposit or U.S. government securities as **initial margin** with the exchange member simply for initiating a transaction. In most cases, the amount is small, involving less than 5 percent of the underlying asset's value. Initial margin represents a good faith deposit that serves to cover losses if prices move against the trader. Exchange members also require traders to meet **maintenance margin** requirements that specify the minimum deposit allowable at the end of each day. Unlike margin accounts for stocks, futures margin deposits represent a form of performance bond by which a trader guarantees that mandatory payment obligations will be met. When the margin deposit falls below this minimum, the customer must deposit more funds or the exchange member can close out the account.

As futures prices vary prior to expiration of the contract, each trader must either increase the cash deposit or can withdraw any excess deposit, depending on whether prices move unfavorably or favorably. For example, a trader who buys a futures contract agrees to pay the negotiated price at delivery.<sup>1</sup> If the futures price increases in the interim, the market value of the initial position also rises and the buyer can withdraw this increase in contract value. If, instead, the futures price falls, the value of the initial position declines and the buyer must cover this decrease in value. Formally, exchange members identify the change in value of each trader's account at the end of every day, then credit the margin accounts of those with gains and debit the margin accounts of those with losses. The market labels this daily settlement process **marking-to-market** and the daily change in value as **variation margin**.

Every futures contract has a formal expiration date. At expiration, trading stops and participants settle their final positions. Contracts may provide for either physical delivery of the underlying asset or a cash settlement. With physical delivery, the buyer of futures will make a cash payment to a seller, while the seller supplies the physical asset. Because financial futures contracts involve securities, delivery is handled via the wire transfer of funds and securities. With cash settlement, there is no physical delivery as participants simply exchange the final change in position value after the last trading day. Less than 1 percent of financial futures contracts require physical delivery at expiration because most participants offset their futures positions in advance.

### AN EXAMPLE: 90-DAY EURODOLLAR TIME DEPOSIT FUTURES

One of the most liquid interest rate futures contracts is the 90-day Eurodollar time deposit future. Its popularity is due to the breadth of participants who use Eurodollars, the allowance for cash settlement at delivery, and the

---

<sup>1</sup>Futures contracts with cash settlement at delivery differ from contracts with physical delivery in that traders settle their positions by paying or receiving the change in value of the contract between the trade date and expiration date.

**EXHIBIT  
7.1**

## Data for 3-Month Eurodollar Futures on March 10, 2005

Eurodollar (CME)-\$1,000,000; pts of 100%								
Mar	96.98	96.99	96.98	96.99	—	3.91	—	823,734
Apr	96.81	96.81	96.81	96.81	-.01	3.19	.01	19,460
June	96.53	96.55	96.52	96.54	—	3.46	—	1,409,983
Sept	96.14	96.17	96.13	96.15	-.01	3.05	.01	1,413,496
Dec	95.92	95.94	95.88	95.91	-.01	4.09	.01	1,146,461
Mr06	95.78	95.80	95.74	95.77	-.01	4.23	.01	873,403
June	95.64	95.60	95.62	95.64	-.01	4.34	.01	567,637
Sept	95.37	95.58	95.53	95.54	-.01	4.44	.01	434,034
Dec	95.47	95.50	95.44	95.47	—	4.53	—	300,746
Mr07	95.42	95.44	95.37	95.42	—	4.58	—	250,271
June	95.31	95.38	95.31	95.37	.01	4.63	-.01	211,664
Sept	95.27	95.32	95.23	95.31	.02	4.69	-.02	164,295
Dec	95.21	95.27	95.18	95.26	.03	4.74	-.03	154,123
Mr08	95.16	95.23	95.11	95.21	.04	4.79	-.04	122,800
June	95.08	95.17	95.07	95.14	.05	4.84	-.05	113,790
Sept	95.03	95.13	95.01	95.11	.06	4.89	-.06	107,792
Dec	94.95	95.06	94.94	95.05	.07	4.95	-.07	96,046
Mr09	94.91	95.02	94.89	95.01	.08	4.99	-.07	81,015
June	94.05	94.97	94.84	94.97	.08	5.03	-.08	76,224
Sept	94.81	94.93	94.79	94.92	.08	5.08	-.08	41,524
Dec	94.77	94.38	94.74	94.87	.08	5.15	-.08	40,594
Mr10	94.77	94.64	94.70	94.83	.09	5.27	-.09	17,481
Sept	94.66	94.76	94.62	94.75	.09	5.25	-.09	9,309
Sp11	94.58	94.60	94.47	94.60	.09	5.40	-.09	2,583
Dec	94.49	94.56	94.43	94.56	.09	5.44	-.09	2,358
Mr12	94.48	94.54	94.41	94.53	.09	5.47	-.09	1,392

Est vol 2,082,746; vol Wed 1,519,709; open int 8,631,643, +160,422.

SOURCE: *The Wall Street Journal*, March 11, 2005.

growth of interest rate swaps and option contracts based on LIBOR. Chapter 2 briefly introduced cash market Eurodollars as comparable to jumbo CDs in the domestic market. Chapter 8 describes cash market Eurodollar time deposits in detail.

Eurodollar futures contracts are traded on the International Monetary Market (IMM), a division of the Chicago Mercantile Exchange.<sup>2</sup> The underlying asset is a Eurodollar time deposit with a 3-month maturity. Conceptually, Eurodollars are U.S. dollar-denominated deposits in banks located outside the United States. The holder cannot write checks against the account but earns interest at a rate slightly above that on domestic CDs issued by the largest U.S. banks. Eurodollar rates are quoted on an interest-bearing basis assuming a 360-day year. Each Eurodollar futures contract represents \$1 million of initial face value of Eurodollar deposits maturing three months after contract expiration. More than 40 separate contracts are traded at any point in time as contracts expire in March, June, September, and December, more than 10 years out from the current date.<sup>3</sup> Settlement or delivery is in the form of cash, with the price established from a survey of current Eurodollar rates.

Eurodollar futures contracts trade according to an index that equals 100 percent minus the futures interest rate expressed in percentage terms. An index of 93.50, for example, indicates a futures rate of 6.5 percent. Each basis point change in the futures rate equals a \$25 change in value of the contract ( $0.0001 \times \$1 \text{ million} \times 90/360$ ). If futures rates increase, the value of the contract decreases and vice versa.

Buyers of Eurodollar futures are classified as “long” because they own a commitment regarding the final price that can be realized at expiration. Sellers are said to be “short” because they may ultimately be forced to come up with cash they may not currently have. With cash settlement, buyers and sellers of Eurodollar futures have simply agreed on the price at expiration. What the buyer owns is a commitment from the seller to pay cash if the price of the underlying asset rises in the interim. The seller owns a commitment from the buyer to pay cash if the asset price falls. Buyers make a futures profit when futures rates fall (prices rise), while sellers gain when futures rates rise (prices fall). Conceptually, profits arise because buyers can offset their initial position by selling the same futures contract after prices have increased. Sellers can similarly profit if they can buy the futures back at a lower price after rates rise. As indicated earlier with daily settlement, the Eurodollar futures contract changes in value daily when prices change, and participants can withdraw profits from their margin accounts prior to expiration.

Exhibit 7.1 indicates how *The Wall Street Journal* reports price quotes for these 3-month Eurodollar futures contracts for the close of business on March 10, 2005. The first column indicates the settlement month and year. The first six contracts expire during the month noted in 2005. Except for the upcoming year, these contracts expire sequentially at 3-month intervals near the middle of each month. Each row lists price and yield data for a

<sup>2</sup>Equivalent Eurodollar futures contracts are traded on the Singapore International Monetary Exchange.

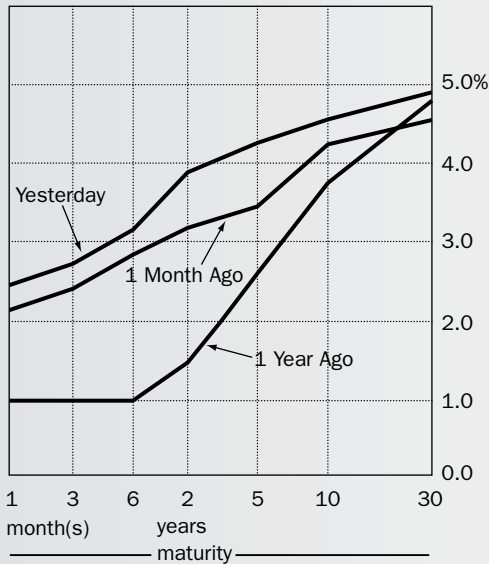
<sup>3</sup>During the upcoming year, contracts are added for intervening months. Subsequent exhibits do not reveal price quotes for all Eurodollar futures contracts. The last day of trading (expiration day) is the second London business day prior to the third Wednesday in each delivery month.

**EXHIBIT  
7.2**

## Yield Curve Data for March 10, 2005

**Treasury Yield Curve**

Yield to maturity of current bills, notes and bonds.



Source: Reuters

**Libor/Swap Curve**

Counterparty receives (mid-market) semi-annual swap rates for 2 to 30 years and pays floating 3-month Libor.



Source: Prebon Yamane (USA)

SOURCE: *The Wall Street Journal*, March 11, 2005.

distinct futures contract. The next four columns report the index price quotes for each contract during the day, including the opening price, high and low price, and closing settlement price. The next column headed CHG indicates the change in settlement price from the previous day. The data under YLD convert the settlement price to a Eurodollar futures rate as:

$$100 - \text{settlement price} = \text{futures rate}$$

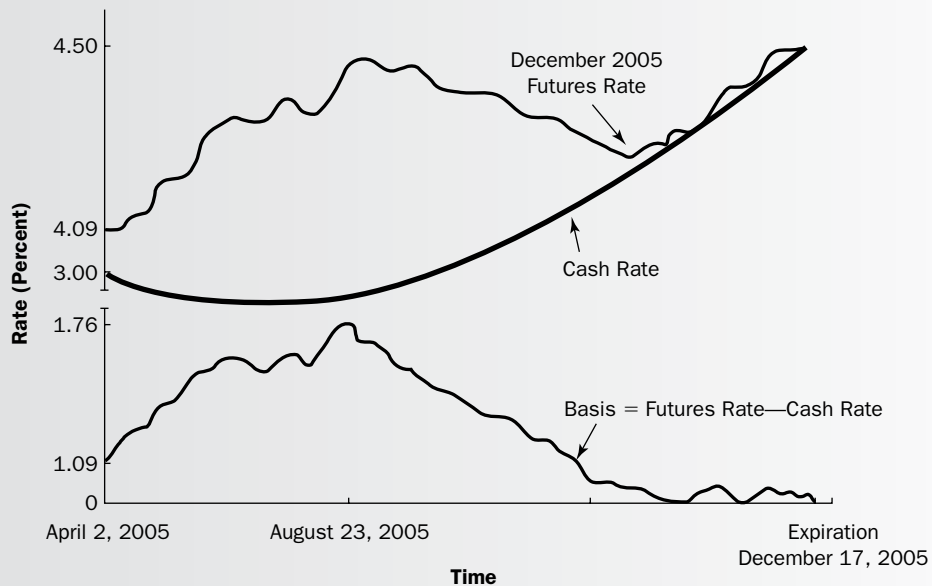
The second CHG column indicates the yield change from the previous day. The final column reports **open interest** equal to the total number of futures contracts outstanding at the end of the day.

For example, the Eurodollar futures contract expiring in March 2006, one year in the future, had a settlement price of 95.77 for a futures rate of 4.23 percent. On March 10, 2005, the contract opened trading at 95.78, rose as high as 95.80, and fell as low as 95.74 during the day, before trading stopped. The closing price was 1 basis point below the close the prior day, indicating that the futures rate rose 1 basis point. At the close of business 873,403 contracts were outstanding. Each successive row of data provides similar information. Note the column for the settlement yield, which is also labeled the futures rate. The data generally indicate that the farther out is contract expiration, the higher is the futures rate. Thus, the 3-month Eurodollar futures rate of 4.34 percent for the contract expiring in June 2006 is 11 basis points higher than that for the March 2006 contract, but is less than the 5.47 percent futures rate for the March 2012 contract. The market exhibited minimal volatility on this day as only a few of the futures rates increased relative to their values the previous day, and the rate change was just 1 to 3 basis points. Finally, the open interest demonstrates that the amount of contracts outstanding declines the farther out is expiration, consistent with the fact that liquidity is greatest for the nearby futures contract and generally decreases with time until expiration.

Exhibit 7.2 presents two yield curves at the close of business on March 10, 2005. Figure A represents the yield curve for U.S. Treasury securities in which rates ranged from 2.60 percent on 1-month T-bills to 4.85 percent on 30-year bonds. Note the increase in rates from one month prior and one year prior. Note also the relatively steep slope as the difference between the 1-month and 30-year Treasury rates was 225 basis points. However, it was not nearly as steep as the yield curve one year prior. According to the unbiased expectations theory, an upsloping yield

**EXHIBIT  
7.3**

The Relationship Between Futures Rates and Cash Rates—One Possible Pattern



curve indicates a consensus forecast that short-term interest rates are expected to rise. A flat yield curve suggests that rates will remain relatively constant. One interpretation of futures rates is that they provide information about consensus expectations of future cash rates. Futures rates that increase the farther out is futures contract expiration presumably indicate an expected increase in rates. In this context a futures rate should provide similar information as a forward rate derived from cash rates representing the prevailing yield curve. Data for the LIBOR swap curve, which is defined later in the chapter, reveal a similar pattern as that for the Treasury yield curve. If these Eurodollar futures rates are viewed as forecasts of 3-month Eurodollar cash rates at expiration of each futures contract, the sharp increase suggests a rising Eurodollar yield curve as well.

**DAILY MARKING-TO-MARKET**

The cash flows associated with daily settlement of futures trading can be demonstrated by an example. Consider a trader who at the close of trading on March 10, 2005, buys one December 2005 3-month Eurodollar futures contract at \$95.91, or 4.09 percent, posting \$1,100 in cash as initial margin. Maintenance margin is set at \$700 per contract. The futures contract expires on December 17, approximately nine months after the initial purchase, during which time the futures price and rate fluctuate daily. Because our trader is long futures, the contract increases in value when the futures price rises, or the futures rate declines. Suppose that on March 3 the futures rate falls to 3.99 percent. The trader could withdraw \$250 (10 basis points  $\times$  \$25) from the margin account, representing the increase in value of the position. For this example, assume that the funds are left in the margin account. Now suppose that the futures rate increases to 4.15 percent the next day so that the trader's long position decreases in value. The 16 basis point increase represents a \$400 drop in margin such that the ending account balance would equal \$950. If at market close on March 11 the December futures rate increases further to 4.30 percent, the trader must make a variation margin payment sufficient to bring the account up to \$700. In this case, the account balance would have fallen to \$575 and the margin contribution would equal \$125. The exchange member may close the account if the trader does not meet the variation margin requirement.

Exhibit 7.3 reveals one possible pattern in the movement of the 3-month cash Eurodollar rate and the December 2005 futures rate after March 10. Initially, the cash rate equals 3 percent and the futures rate is 4.09 percent. While the cash rate declines initially then increases systematically until expiration, the futures rate immediately increases. When the contract expires on December 17, 2005, both the futures and cash rate equal 4.50 percent, and the long futures position is worth \$1,025 (41 basis points  $\times$  \$25) less than its value on March 10, 2005, because the Eurodollar futures rate increased 41 basis points. If the trader held the contract to expiration, the position would have immediately decreased in value as the futures rate rose and would have remained at a loss through

expiration because the futures rate never went below 4.09 percent. The trader would have lost a total of \$1,025 at the close or some lesser amount if he got out of his position earlier.

**THE BASIS.** The term **basis** refers to the cash price of an asset minus the corresponding futures price for the same asset at a point in time. Typically, it applies to the cash price of a security that is being hedged. For Eurodollar futures, the basis can be calculated as the futures rate minus the cash rate. Consider the previous example with 3-month December 2005 Eurodollar futures. On March 10, 2005, the cash 3-month Eurodollar time deposit rate equaled 3 percent. Thus, the December 2005 futures rate exceeded the prevailing cash rate by 109 basis points, which represents the basis. The bottom part of Exhibit 7.3 shows the movement in the basis associated with the cash and futures rates presented at the top of the exhibit. It initially increases to almost 176 basis points on August 23, then systematically declines as expiration approaches. Note that the basis equals zero at expiration and is close to zero prior to expiration. This is a typical pattern. Later discussions will indicate that the basis is important in determining the effectiveness of hedging interest rate risk.

The basis may not behave as nicely as it does in Exhibit 7.3. It may be positive or negative, depending on whether futures rates are above or below cash rates, and may swing widely in value far in advance of contract expiration. The basis rises and falls daily as economic conditions and market sentiment change. While the basis can take any value, there are two general price relationships between futures and cash instruments. First, the basis must equal zero at expiration. This is so no trader can earn a riskless arbitrage profit. For example, suppose that the basis equals some nonzero value just prior to expiration. Any trader could buy the cheaper cash instrument or futures contract and sell the more expensive one, making a riskless profit. Such arbitrage drives the two prices together. Second, because futures and cash rates must be equal at expiration, the basis normally narrows as expiration approaches. If it is positive, it declines to zero. If it is negative, it increases to zero. Both phenomena are demonstrated in Exhibit 7.3.

## SPECULATION VERSUS HEDGING

Participants use futures for a variety of purposes. According to the previous discussion, futures prices may represent the consensus forecast of the underlying asset's future price at contract expiration. A trader who expects the actual price to differ from that expected and represented by the futures price can either buy or sell the future, depending on whether the contract is perceived to be undervalued or overvalued. Such a participant is a speculator who takes on additional risk to earn speculative profits. For example, a speculator who on March 10, 2005, believed that December 2005 Eurodollar futures at 4.09 percent were undervalued (futures price [rate] was too low [high]) would buy the contract, anticipating a decline in futures rates and an increase in price prior to expiration. Speculators who felt the contract was overvalued (futures price [rate] was too high [low]) would alternatively sell futures, expecting to make a profit after futures rates increased and prices fell.

The top part of Exhibit 7.4 characterizes speculation in terms of two profit diagrams for the December 2005 Eurodollar futures data from Exhibit 7.1. The first (A) summarizes the profits and losses from buying the futures contract at the settlement price relative to possible futures prices after the contract is purchased. Specifically, on March 10, 2005, the settlement price equals 95.91. If a speculator later sells the futures contract at any higher price, he or she earns a profit equal to \$25 times the difference in the sales price and 95.91. If the futures price declines and the speculator sells at less than 95.91, he or she suffers a loss. The second diagram (B) summarizes profits and losses for the seller of the same futures contract on March 10. Not surprisingly, the seller profits when the futures price declines and loses when the price rises.

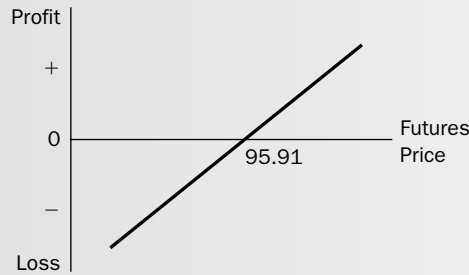
Speculation is extremely risky. For the most part, futures rates and prices on nearby contracts are determined by arbitrage activity. Even when a speculator views a contract as overvalued or undervalued, any position taken can backfire in that a major market move can overwhelm the initial mispricing. Exhibit 7.4 demonstrates that the loss potential is virtually unlimited. Pure speculative activity with single contracts is thus relatively rare.

Hedging differs from speculation in terms of the participants' risk position prior to executing a trade and overall trade objectives. Speculators take a position that increases their risk profile. Hedgers focus on avoiding or reducing risk. They enter futures transactions because their normal business operations involve certain risks that they are trying to reduce. This preexisting risk can be at least partially offset because futures prices tend to move directly with cash prices, so futures rates closely track cash interest rates. Hedgers take the opposite position in a futures contract relative to their cash market risk so that losses in one market are reduced by gains in the other market.

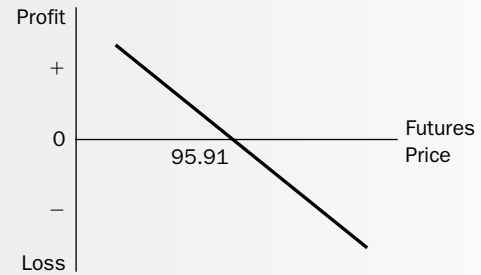
For example, a trader who loses when cash market interest rates decrease will normally gain in the futures market with a long position as futures rates (prices) also decrease (increase) and the contract increases in value. This is characterized at the bottom of Exhibit 7.4. The lower left diagram adds to the long futures position a dashed line that indicates the profit and loss from an unhedged cash position. In this case the hedger loses in the cash market when prices increase (rates decrease) and gains when prices decrease (rates increase). In a *perfect hedge* the net profit, denoted by adding the profits and losses on both the futures and cash position, equals zero at each price. This is charac-

**EXHIBIT  
7.4**

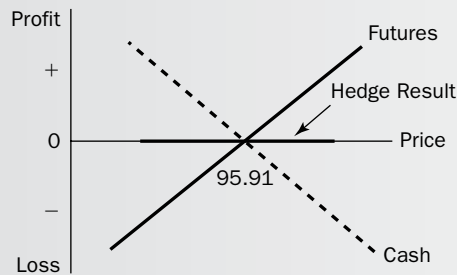
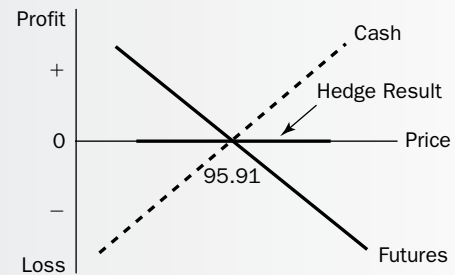
Profit Diagrams for the December 2005 Eurodollar Futures Contract from Exhibit 7.1

**A. Speculation**

1. Buy Dec. 2005 Eurodollar Futures at 95.91



2. Sell Dec. 2005 Eurodollar Futures at 95.91

**B. Hedging**Hedge: Long Futures—Cash Loss When  
Rates FallHedge: Short Futures—Cash Loss When  
Rates Rise

terized by the bold horizontal line at the zero profit level. The diagram on the lower right demonstrates the identical result when a short futures position is used to offset losses from a cash position that loses when prices fall (interest rates rise). Note here that rate increases (price decreases) produce simultaneous cash losses and futures profits. Rate decreases (price increases), in turn, produce simultaneous cash profits and futures losses, hence the hedge.

Participants also use futures because transactions costs are lower with futures than cash assets. Subsequent hedges are really transactions whereby participants can essentially replicate cash market positions but lower their cost of taking a position. For example, an investor who has funds to invest for nine months in the Eurodollar market on March 10 could simply buy a 9-month Eurodollar time deposit. Alternatively, he or she could buy a 3-month Eurodollar time deposit and 3-month Eurodollar futures contracts that expire in June 2005 and September 2005, respectively. The latter might be attractive if the combined yield exceeds that for the 9-month Eurodollar net of transactions costs.

**Steps in Hedging.** In general, there are seven basic steps in implementing futures hedges for financial institutions:

1. Identify the cash market risk exposure that management wants to reduce.
2. Based on the cash market risk, determine whether a long or short futures position is appropriate to reduce risk.
3. Select the best futures contract.
4. Determine the appropriate number of futures contracts to trade.
5. Implement the hedge by buying or selling futures contracts.
6. Determine when to get out of the hedge position, either by reversing the trades in Step 5, letting contracts expire, or making or taking delivery.
7. Verify that futures trading meets regulatory requirements and conforms to the bank's internal risk management policies.

The first step indicates that hedging requires each futures position to be associated with a cash position and that the objective is to reduce risk. The second step follows from Exhibit 7.4, and the fact that cash and futures rates on similar underlying instruments generally move in the same direction. If losses arise in the cash market when cash rates fall, a hedger will buy futures contracts because the futures should gain when futures rates fall. Similarly, if losses arise when cash rates rise, a hedger will sell futures contracts. The third step suggests that there is a “correct” futures contract for each cash position. In fact, the best contract is only known after the fact. What is known at the time of trading is that a hedger wants a futures contract whose rate will change in the same direction and by the same magnitude as the cash rate. Thus, a hedger chooses a “correct” futures contract where the correlation between the cash rate and futures rate is high. The other question is what contract expiration is best? Generally, a hedge will remain in place for a predetermined time interval. For reasons discussed later related to minimizing basis risk, a hedger will also generally trade the futures contract that expires immediately after the date at which the cash market risk disappears.

The fourth step addresses the determination of the appropriate *hedge ratio*, or number of futures contracts relative to the cash market exposure. There are several procedures for this, depending on whether the hedger’s objective is to minimize the expected return variance or the change in total portfolio value. An example is provided later, but a detailed analysis of hedge ratios is left to other texts. The fifth step refers to the actual execution of the futures contracts trading based on the analysis of Steps 1–4. Along with the decision to hedge, a hedger decides how long the hedge should be in place. In most cases, the cash market risk exposure exists for a predetermined period of time. Once cash market risk is eliminated, a hedger will get out of the hedge position. To continue to hold a long or short futures position with no linked cash position would be speculating, because changes in the futures contract would not offset any associated change in the cash position. Thus, the sixth step involves identifying when cash market risk either disappears or reaches an acceptable level.

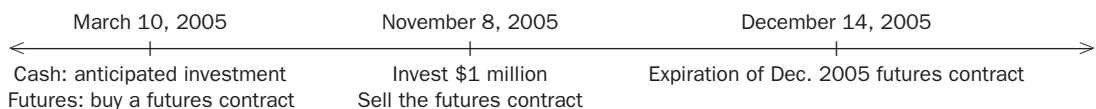
A futures trade that serves as a hedge will generally be kept in place as long as the cash risk exposure exists, and will be offset once the exposure is gone. There are two important extensions. First, if the cash market risk is unchanged over a period of time, it is inappropriate to trade futures contracts in and out in an attempt to time market movements. For example, a bank that trades futures in order to reduce the risk of price volatility with a portfolio of bonds should take an initial position and hold it until the bonds are sold, mature, or management decides to alter its risk preference. The bank should not sell futures initially, then buy them back only to sell futures again prior to the above ending points. Such day trading or position trading is speculative and simply increases commission costs. Second, management should determine a priori what its desired risk exposure is. It is appropriate for management to change its preference for risk and time whether it is hedged or unhedged accordingly. These risk preferences should not, however, change frequently over short periods such that management is constantly buying and selling futures against an unchanged cash market position. To do so is speculative because the implicit unstated intent is to time interest rate movements and trade futures to profit, rather than to reduce risk.

Finally, banks must meet strict regulatory guidelines and management must have internal policies in place that authorize hedge trades. Specifically, only certain types of positions are allowed for futures trading to constitute a hedge. Among other requirements, banks must maintain a contemporaneous hedge log that associates futures trades with the cash position in terms of the objective and nature of the trade, and they must meet strict accounting requirements for hedge gains and losses.

## A LONG HEDGE

As indicated in Exhibit 7.4, a long hedge is applicable for a participant who wants to reduce cash market risk associated with a decline in interest rates. The applicable strategy is to buy futures contracts on securities similar to those evidencing the cash market risk. If cash rates decline, futures rates will typically also decline so that the value of the futures position will likely increase. Any loss in the cash market is at least partially offset by a gain in futures. Of course, if cash market rates increase, futures rates will also increase and the futures position will show a loss. Using futures essentially fixes a rate or price. This latter instance reveals an important aspect of hedging. If cash rates rise, the investor will profit more from not hedging because cash rates move favorably. A hedger thus forgoes gains associated with favorable cash market price moves. The hedge objective, however, is assumed to be risk reduction. With hedging, risk is lower because the volatility of returns is lower.

The following example applies the key steps in hedging to a bank that implements a Eurodollar futures hedge. Consider the following time line:



Suppose that on March 10, 2005, your bank expects to receive a \$1 million payment on November 8, 2005, and anticipates investing the funds in 3-month Eurodollar time deposits. If the bank had the funds in hand in March, it would immediately buy Eurodollar deposits. The cash market risk exposure is that the bank would like to invest

the funds at today's rates, but will not have access to the funds for seven months. If cash rates move lower between March and November, the bank will realize an opportunity loss because it will have to invest the \$1 million at rates below those available today. In March 2005, the market expected Eurodollar rates to increase as evidenced by rising futures rates. In order to hedge, the bank should buy futures contracts such that if cash rates fall, futures rates will also likely fall and the long futures position will increase in value as an offset to the cash losses. Also, if futures rates overstate the likely increase in Eurodollar rates, a long position may capture any benefit. The best futures contract will generally be the December 2005, 3-month Eurodollar futures contract, which is the first to expire after November 2005. The contract that expires immediately after the known cash transactions date is generally best because its futures price will show the highest correlation with the cash price.

Using the data in Exhibit 7.1, the December 2005 futures rate equals 4.09 percent while the current cash market rate equals 3 percent. This produces a basis of 1.09 percent. Exhibit 7.5 summarizes hedge results, assuming the bank buys a December futures contract on March 10 and sells it on November 8, when the bank actually buys Eurodollars in the cash market. The 3-month Eurodollar futures contract has a \$1 million par value, so each 1 basis point change in futures rates is worth the same \$25 as a 1 basis point change in cash Eurodollar rates. The assumed hedge ratio is 1-to-1. Note that once the bank buys the futures contract, it is fully hedged. It implements the trade at the time it identifies the cash market risk and decides to reduce the risk. Because it plans to invest the funds in November, its cash risk will no longer exist after that time and the bank will need to get out of its initial long futures position, or it will be speculating. It is assumed that the bank has a hedge policy in place that authorizes futures trading to reduce risk associated with the planned investment of funds and that Eurodollar futures are an acceptable vehicle. It is also assumed that management has the accounting and hedge performance monitoring systems in place. The transactions are summarized at each date under the cash and futures market headings with the basis values in the final column of Exhibit 7.5.

**CHANGE IN THE BASIS.** The basis at the time of hedge initiation and change in basis at the time the hedge is offset determine the risk and net performance of the overall hedged position. Suppose that cash rates rise by 93 basis points through November 8 such that the bank actually invests the \$1 million at 3.93 percent. This investment produces an opportunity gain of \$2,325 in interest for the 3-month period as indicated by the net effect reported in the column under the cash market heading. On November 8, the December 2005 futures rate falls by 6 basis points to 4.03 percent. At that time the bank sells its contract at a higher price (95.97), earning a direct profit of \$150. In this case, the bank gains in both the cash and futures markets. The basis on November 8 is 0.10 percent, or 99 basis points lower than on March 10.

The bank's effective percentage return is calculated at the bottom of Exhibit 7.5. The combined income equals investment income from the cash Eurodollar plus the gain on the futures trade. In this case, income consists of \$9,975 in interest and \$150 in futures profits for a 3.99 percent return relative to the \$1 million investment. This net percentage return is 99 basis points above the initial cash Eurodollar rate on March 10. As demonstrated

## EXHIBIT 7.5

### Long Hedge Using Eurodollar Futures

Date	Cash Market	Futures Market	Basis
3/10/05 (Initial futures position)	Bank anticipates investing \$1 million in Eurodollars in 8 months; current cash rate = 3.00%	Bank buys one December 2005 Eurodollar futures contract at 4.09%; price = 95.91	4.09% - 3.00% = 1.09%
11/8/05 (Close futures position)	Bank invests \$1 million in 3-month Eurodollars at 3.93%	Bank sells one December 2005 Eurodollar futures contract at 4.03%; price = 95.97%	4.03% - 3.93% = 0.10%
Net effect	Opportunity gain: 3.93% - 3.00% = 0.93%; 93 basis points worth \$25 each = \$2,325	Futures profit: 4.09% - 4.03% = -0.06%; 6 basis points worth \$25 each = \$150	Basis change: 0.10% - 1.09% = -0.99%
Cumulative investment income:			
Interest at 3.93% = \$1,000,000(.0393)(90/360) = \$9,825			
Profit from futures trades = \$ 150			
Total = \$9,975			
Effective return = $\frac{\$9,975}{\$1,000,000} \left( \frac{360}{90} \right) = 3.99\%$			

**EXHIBIT  
7.6**

## Short Hedge Using Eurodollar Futures

Date	Cash Market	Futures Market	Basis
3/10/05	Bank anticipates selling \$1 million Eurodollar deposit in 127 days; current cash rate = 3.00%	Bank sells one Sept. 2005 Eurodollar futures contract at 3.85%; price = 96.15	$3.85\% - 3.00\% = 0.85\%$
8/17/05	Bank sells \$1 million Eurodollar deposit at 4.00%	Bank buys one Sept. 2005 Eurodollar futures contract at 4.14%; price = 95.86	$4.14\% - 4.00\% = 0.14\%$
Net result:	Opportunity loss. $4.00\% - 3.00\% = 1.00\%$ ; 100 basis points worth \$25 each = \$2,500	Futures profit: $4.14\% - 3.85\% \times 0.29\%$ ; 29 basis points worth \$25 each = \$725	Basis change: $0.14\% - 0.85\%$ $= -0.71\%$

Effective loss = \$2,500 – \$725 = \$1,775

Effective rate at sale of deposit =  $4.00\% - 0.29\% = 3.71\%$   
or  $3.00\% - (0.71\%) = 3.71\%$

below, the 99 basis point differential also represents the change in basis between March and November (0.10 percent–1.09 percent). The hedge worked because the volatility of the return from the combined futures and cash position was below the volatility of return with the unhedged cash position. With no hedge, the bank would have earned 3.93 percent.

**A SHORT HEDGE**

A short hedge applies to any participant who wants to reduce the risk of an increase in cash market interest rates (or reduction in cash market prices). The applicable strategy is to sell futures contracts on securities similar to those evidencing the cash market risk. If cash rates increase, futures rates will generally increase so the loss in the cash position will be at least partially offset by a gain in value of futures. Again, if cash rates actually decrease, the gain in the cash market will be offset by a loss from futures and a hedger gives up potential gains from an unhedged position. A hedger essentially fixes the rate to be realized.

The following example examines a short hedge associated with a bank that wants to protect the value of its existing securities portfolio from potential losses at future sale. Suppose that on March 10, 2005, a bank anticipates it will need to sell a 6-month Eurodollar deposit from its investment portfolio on August 17. The Eurodollar yields 4.4 percent and management, expecting a sharp increase in interest rates, would like to hedge against a decline in value of the Eurodollar at the time of sale. The cash market risk of loss is that Eurodollar time deposit rates will be higher in August. To hedge, the bank will want to immediately sell Eurodollar futures. The example assumes that the bank immediately sells one September 2005 Eurodollar futures contract and expects to buy it back in August when it sells its cash Eurodollar investment.<sup>4</sup>

Exhibit 7.6 summarizes the hedge results, assuming the bank sells one September 2005 Eurodollar futures contract on March 10 at 3.85 percent. With a cash rate of 3 percent, the initial basis is 0.85 percent. On August 17, the bank buys the futures back when it liquidates its Eurodollar investment. It is assumed in the example that cash rates rise through August such that the deposit rate equals 4 percent at sale and the September futures rate equals 4.14 percent. In this situation, the bank has an (approximate) opportunity loss of \$2,500 on its cash position and a futures profit of \$725 for a net loss of \$1,775.<sup>5</sup> Note that the 100 basis point increase in the cash rate and 29 basis point increase in the futures rate coincide with a 71 basis point decrease in the basis. Unlike the long hedge example, in this case the bank loses in the cash market and profits with futures. The hedge again works in the sense that the volatility of return (or cost) is less than with an unhedged position. If unhedged, the bank would have not

<sup>4</sup>Note that a \$1 million 6-month Eurodollar deposit is priced differently than a \$1 million 3-month Eurodollar deposit. Specifically, each basis point change is now worth \$50 ( $.0001 \times \$1,000,000 \times 180/360$ ). As time elapses, the 6-month Eurodollar will approach maturity such that in August it will have less than two months to maturity.

<sup>5</sup>The calculation assumes that the deposit has exactly 90 days remaining maturity such that a basis point is worth \$25. On August 17, however, the deposit would have less than 90 days to maturity and each basis point would be worth less than \$25.

realized the \$725 futures gain and its total cost at sale of the deposit would have been greater than with the hedge. Of course, the bank would have been in a riskier position without the futures hedge. The important point is that a hedger does not base a futures trade on expected futures profits, but rather on reducing overall risk.

### CHANGE IN THE BASIS

Both the long and short hedges worked in the previous examples in the sense that the futures rate moved in line with the cash rate. With the long hedge, the futures rate fell by 6 basis points as Eurodollar rates did not increase as much as expected. Had the cash rate decreased instead of increased, the bank would have invested its funds at a yield below 3 percent but would have realized a greater profit on its futures position as the contract price increased even more. With the short hedge, the futures rate increased by 29 basis points, producing a profit, while the cash rate rose by 100 basis points. The net effect was that the futures profit and cash loss netted 71 basis points.

The actual risk assumed by a trader in both hedges is not that the level of interest rates will move against the cash position, but that the basis might change adversely between the time the hedge is initiated and closed. The effective return from Exhibit 7.5 equaled total income from the combined cash and futures positions relative to the investment amount. It can also be expressed as:

$$\text{Effective return} = \text{Initial cash rate} - \text{Change in basis} \quad (7.1)$$

or 3.99 percent [3.00 percent  $- (-0.99)$  percent].<sup>6</sup> The change in the basis ( $B_2 - B_1$ ) equals the basis when the hedge is closed ( $B_2$ ) minus the basis when the hedge is initiated ( $B_1$ ). At the time a trade is initiated, the only unknown in Equation 7.1 is the basis value at closing and therefore the size of change in basis. Thus, a hedger still faces the risk that futures rates and cash rates will not change coincidentally. In this long hedge example, the basis decreased from 109 to 10 basis points, thereby raising the return by 99 basis points over the initial cash rate to 3.99 percent. Had the basis increased, the effective return would have decreased. The result holds true regardless of whether the level of rates increased or decreased after March 10.

The effective cost of a short hedge is also determined by Equation 7.1. The risk assumed by a hedger is again that the basis might change between the time a hedge is initiated and the time it is offset. However, the short hedger benefits when the basis increases and loses when the basis decreases. This is the opposite of a hedger who takes a long position. Using the data from the example in Exhibit 7.6, the effective cost of the Eurodollar deposit sale was 3.71 percent equal to 3.00 percent  $- (0.71)$  percent. This indicates that the bank effectively sold the Eurodollar time deposit at a 71 basis point higher yield than the rate available in March. Thus, the bank realized a greater net value by 29 basis points, or \$725, compared with an unhedged sale.

Generally, directional movements in the basis are more predictable than movements in the level of cash market rates and the volatility of cash rates exceeds the volatility of the basis. The risk of hedging is thus normally less than the risk of not hedging. While basis changes can be substantial, most factors that influence cash rates influence futures rates simultaneously. Futures rates are further tied to cash rates by arbitrage activity so that the two rates move together. If the cash instrument to be hedged is the same as the instrument underlying the futures contract, arbitrageurs will trade the two instruments until the basis equals zero at futures contract expiration. This is what induces the basis to narrow toward zero as expiration approaches, per the diagram in Exhibit 7.3, and helps the hedger to estimate the ex post effective cost or return from a hedged position.

### BASIS RISK AND CROSS HEDGING

In a perfect hedge, the profit or loss in the cash position is exactly offset by the profit or loss from the futures position. This would occur if the basis change always equaled zero. In practice, it is extremely difficult to obtain a perfect hedge and there are numerous instances when basis risk can be substantial. One such instance involves **cross hedges**. A cross hedge is one in which a participant uses a futures contract based on one security that differs from the security being hedged in the cash market. An example would be using Eurodollar futures to hedge price movements for commercial paper transactions. The risk is potentially greater for cross hedges because futures and cash interest rates may not move closely together as they are based on different underlying securities. If the basis is volatile and unpredictable, Equation 7.1 suggests that the effective return or cost from a hedge might also be volatile and unpredictable.

Basis risk can also be substantial because futures and cash rates for the same underlying security may move in opposite directions prior to expiration. In fact, the basis change is known with certainty only when the planned cash transactions being hedged coincide with futures expirations. In this case, participants know that the basis will equal zero and thus the basis change will equal the negative of the basis at the time the hedge is initiated. Typically, however, most transactions do not coincide with futures expirations and changes in futures rates may differ

<sup>6</sup>Whenever a participant profits in futures, the effective return is actually higher because it could withdraw variation margin funds and invest the proceeds after futures prices moved favorably.



**EXHIBIT  
7.7**

## Creating a Synthetic 6-Month Eurodollar Liability

**Summary of Relevant Eurodollar Rates and Transactions****March 10, 2005**

3-month cash rate = 3.00%; bank issues a \$1 million, 91-day Eurodollar deposit  
 6-month cash rate = 3.25%  
 Bank sells one September 2005 Eurodollar futures; futures rate = 3.85%

**July 3, 2005**

3-month cash rate = 3.88%; bank issues a \$1 million, 91-day Eurodollar deposit  
 Buy: One September 2005 Eurodollar futures; futures rate = 4.33%

Date	Cash Market	Futures Market	Basis
3/10/05	Bank issues \$1 million, 91-day Eurodollar time deposit at 3.00%; 3-mo. interest expense = \$7,583.	Bank sells one September 2005 Eurodollar futures contract at 3.85%	0.85%
7/3/05	Bank issues \$1 million, 91-day Eurodollar time deposit at 3.88%; 3-mo. interest expense = \$9,808 (increase in interest expense over previous period = \$2,225).	Bank buys one September 2005 Eurodollar futures contract at 4.33%;	0.45%
Net effect:	6-mo. interest expense = \$17,391	Profit on futures = \$1,200	

$$\text{Effective 6-mo. borrowing cost} = \frac{\$17,391 - \$1,200}{\$1,000,000} \frac{(360)}{(182)} = 3.20\%$$

Interest on 6-month Eurodollar deposit issued March 10 = \$13,144 at 3.25%; vs. 3.20% from synthetic liability

benefit, of course, depends on how cash rates change relative to futures rates. In essence, the bank has substituted basis risk for the risk that cash rates will change adversely. In this example, the bank could lose if cash rates increased substantially more than futures rates increased. Briefly, the true borrowing cost increases as the basis decreases, while the cost falls as the basis increases.

**THE MECHANICS OF APPLYING A MICROHEDGE**

A bank should carefully analyze the opportunities and risks associated with hedging. The following discussion demonstrates the type of information required and procedural steps underlying successful hedging programs.<sup>7</sup>

**DETERMINE THE BANK'S INTEREST RATE RISK POSITION.** To formulate the correct hedge, management must determine the bank's interest rate risk position. With a microhedge this involves examining the bank's actual and anticipated cash market position and how specific interest rate changes will affect interest income or interest expense, or the value of an underlying asset or liability. The objective is to know in what rate environment the bank loses. Frequently, banks then compare their rate forecast and their potential losses if these rates materialize. Selectively hedging when losses will arise if the forecast is realized is a form of speculation. The key hedging decision involves determining how much risk the bank will accept.

**FORECAST THE DOLLAR FLOWS OR VALUE EXPECTED IN CASH MARKET TRANSACTIONS.** To determine how many futures contracts are necessary, management should estimate the dollar magnitude of anticipated cash flows with cash market transactions. This may equal the amount of investable funds, the size of a loan commitment, or the amount of liabilities to be issued or rolled over.

**CHOOSE THE APPROPRIATE FUTURES CONTRACT.** A bank should select a hedging vehicle that reduces interest rate risk. Because changes in the basis determine hedging risk, the appropriate futures contract is usually one whose rates most highly correlate with those of the cash asset or liability being hedged. Typically, the correlation is highest for like instruments, such as Eurodollar futures relative to cash Eurodollar deposits. If a like futures instrument is unavailable, a bank can examine historical correlations for different futures contracts and choose the contract with the highest correlation coefficient. As described earlier, the use of a futures contract that is not identical to the cash instrument being hedged is referred to as a cross hedge. It is also important to assess the

<sup>7</sup>This analysis is based on steps outlined by Kawaller (1983).

liquidity of different contracts. Only when trading volume is large can a bank easily buy or sell futures at relatively stable basis levels.

**DETERMINE THE CORRECT NUMBER OF FUTURES CONTRACTS.** Five factors, listed below, determine the correct number of futures contracts. This calculation, or hedge ratio, is expressed numerically as:

$$NF = \frac{A \times M c}{F \times M f} b$$

where

NF = Number of futures contracts

A = Dollar value of cash flow to be hedged

F = Face value of futures contract

Mc = Maturity or duration of anticipated cash asset or liability

Mf = Maturity or duration of futures contract

b =  $\frac{\text{expected rate movement on cash instrument}}{\text{expected rate movement on futures contract}}$

If futures rates are expected to move coincidentally with cash rates, b equals 1. If futures rates are expected to exhibit larger moves relative to cash rates, b is less than 1, and vice versa.<sup>8</sup> Using the information from Exhibit 7.7 and assuming b equals 1 with Eurodollar cash and futures rates, the bank needed one futures contract:

$$NF = \frac{\$1,000,000 \times 91 \text{ days}}{\$1,000,000 \times 90 \text{ days}} \times 1 = 1$$

**DETERMINE THE APPROPRIATE TIME FRAME FOR THE HEDGE.** Typically, a bank matches the length of a hedge with the timing of cash flows for the underlying asset or liability. For example, a bank that knows it will have funds to invest in six months will use a futures contract that expires in six or more months. If consecutive cash flows are expected, such as principal payments on a term loan, a bank will hedge by spreading different futures contracts over the term of the cash flows. This process, labeled **stripping futures**, consists of buying or selling equal amounts of successive futures contracts.<sup>9</sup>

**MONITOR HEDGE PERFORMANCE.** Once a hedge is in place, management should monitor interest rate changes and the bank's cash position to verify the hedge performance. One concern is that the anticipated cash position might vary. Another is that the basis might move against the cash rate, whereby the bank loses in both the cash and futures market. If the bank's risk profile changes, it may want to lift a hedge. In practice, many participants adjust their hedge when the basis moves against them, implicitly extrapolating that the movement is permanent. In doing so, they are speculating.

## MACROHEDGING APPLICATIONS

Macrohedging focuses on reducing interest rate risk associated with a bank's entire portfolio rather than with individual components or transactions. As suggested in Chapters 5 and 6, macrohedging assumes that interest rate risk is best evidenced by GAP or duration gap measures and by the sensitivity of bank earnings and MVE. Banks can subsequently use futures contracts to hedge this net portfolio rate sensitivity.

### HEDGING: GAP OR EARNINGS SENSITIVITY

When establishing a macrohedge, a bank should initially examine its aggregate interest rate risk position. Banks using GAP and earnings sensitivity analysis focus on the volatility in net interest income. GAP represents the dollar magnitude of rate-sensitive assets minus the dollar magnitude of rate-sensitive liabilities over different time in-

<sup>8</sup>In practice, the appropriate factor is determined as the slope of the regression line from running a regression of cash price changes on futures price changes using historical data.

<sup>9</sup>If the term of the cash flows exceeds the time frame for which futures contracts are available, hedgers can "stack" contracts by loading up on the last available contract and systematically switching into new futures contracts as they become available. This involves additional risk and increases transactions costs.

tervals. If GAP is positive, the bank is said to be asset-sensitive because its net interest income rises when interest rates rise, and falls when interest rates fall. If GAP is negative, the bank is liability-sensitive because net interest income falls when rates increase, and rises when rates decrease. The magnitude of the potential change in net interest income indicates the sensitivity of earnings to rate changes and the aggregate amount of interest rate risk assumed.

Hedging strategies focus on whether a bank is asset or liability sensitive and the extent to which rate changes might alter net interest income. To balance asset sensitivity, a bank will institute a long hedge, whereby declining interest rates should generate futures profits that offset the decline in net interest income. To balance liability sensitivity, a bank will institute a short hedge. If rates subsequently increase and the bank's net interest income falls, the sale of futures should produce a profit that at least partially offsets the lost net interest income.

Consider the summary rate sensitivity data for ABC bank from Exhibit 5.7 in Chapter 5. This bank has a negative cumulative GAP through one year of over \$15,448,000 under management's most likely rate scenario. Exhibit 5.9 demonstrates that if rates increase by 1 percent, net interest income will likely fall modestly the next year, but will fall by almost \$750,000 two years out. Suppose that the bank chooses to hedge \$10 million of its \$15.4 million GAP exposure over 180 days. This partial hedge would call for the sale of 20 Eurodollar futures contracts determined by:

$$NF = \frac{\$10,000,000}{\$1,000,000} \times \frac{180 \text{ days}}{90 \text{ days}} \times 1.0 = 20$$

This assumes that the bank uses Eurodollar futures and that the expected movement between the effective interest rate on the rate-sensitive liabilities relative to the Eurodollar futures rate equals 1. The bank would likely sell 10 September 2005 and 10 December 2005 contracts that expire more than six months from year-end 2004, liquidating the hedge by periodically buying back futures at selected intervals. The hedge should work because any decline in net interest income due to rising rates should be offset by a gain on the short futures position. Also, any gain in net interest income from falling rates should be offset by a loss on the short futures position.

This type of hedge is clearly a cross hedge as the cash rate is actually a combination of several rates, all different from the Eurodollar futures rate. The bank is negatively gapped with the magnitude of change in net interest income associated with changes in short-term liability rates. The bank might alternatively choose Treasury bill futures for the hedge instrument if the correlation was higher with liability rates because money market deposit accounts pay interest tied to cash Treasury bill rates. Because the hedge matches gains in either cash or futures market with losses in the other, the transaction essentially fixes a rate or outcome before basis changes. In effect, the short hedge moves both the GAP and earnings sensitivity closer to zero.

### HEDGING: DURATION GAP AND MVE SENSITIVITY

One of the presumed advantages of duration gap analysis is that it lends itself to hedging applications. Duration gap is a single-valued measure of total interest rate risk in which a bank targets its market value of equity MVE. Duration gap equals the weighted duration of bank assets minus the product of the weighted duration of bank liabilities and the bank's debt-to-asset ratio. A positive duration gap (DGAP) measure indicates that aggregate assets will vary more in value relative to aggregate liabilities when interest rates change equally. If rates increase, the market value of assets falls more than the market value of liabilities, so that MVE declines. A bank with a negative duration gap will see its equity increase in value when rates rise.

To eliminate this risk, a bank could structure its portfolio so that the duration gap equals zero. Alternatively, it can use futures to balance the value sensitivity of the portfolio. Equation 7.3 is listed below:

$$\frac{\Delta MVE}{\text{Market value of assets}} = - \frac{DGAP \times \Delta y}{(1 + y)} \quad (7.3)$$

where DGAP equals the duration gap and  $y$  equals the average interest rate for a bank's portfolio. If management wants to immunize EVE, it could set the bank's DGAP at zero. This can be done by using futures to create a synthetic DGAP that approximately equals zero. The appropriate size of a futures position can be determined by solving Equation 7.4 for the market value of futures contracts (MVF), where DF is the duration of the futures contract used, DA is the weighted duration of assets, and DL is the weighted duration of liabilities:<sup>10</sup>

$$\frac{DA(MVRS_A)}{(1 + i_A)} - \frac{DL(MVRS_L)}{(1 + i_L)} + \frac{DF \times (MVF)}{(1 + i_F)} = 0 \quad (7.4)$$

<sup>10</sup>Because futures contracts have no fixed price or cash flow, they have no duration. Under certain assumptions, however, it can be shown that the duration of a futures contract equals the duration of the underlying deliverable instrument.

## CONTEMPORARY ISSUES



### HEDGE ACCOUNTING AND THE FAILURE OF FRANKLIN SAVINGS

On February 16, 1990, the Office of Thrift Supervision (OTS) put Franklin Savings of Ottawa, Kansas, in receivership. Ernest Fleischer, Franklin's CEO, challenged the seizure in court claiming that the action was arbitrary and capricious. The fundamental issue was whether Franklin Savings was insolvent. The determination evolved around the appropriate procedure in accounting for hedge losses.

Franklin Savings was an unorthodox thrift institution that availed itself of Federal Home Loan Bank advances and jumbo CDs obtained via brokers to fund much of the firm's assets. Franklin, in turn, used a variety of financial futures, options on

financial futures, and interest rate swaps to hedge against loss from adverse changes in interest rates. Franklin employed an absolute value method for computing the correlation coefficient between futures price changes and cash price changes. The OTS used a net offset method.

In February 1990, the absolute value method produced a sufficiently high correlation coefficient for Franklin to qualify for hedge accounting and thus the deferral of losses. The net offset method, in contrast, produced a low correlation coefficient to where the OTS required Franklin to immediately recognize \$119 million in losses that had been previously deferred. With the losses, the OTS determined that Franklin's net worth (capital) was deficient and forced the firm into receivership.

Franklin originally used the net offset method but changed to the absolute value method, which it developed, when the volatility of interest rates increased. The argument was that the net offset procedure distorted the impact of rapidly changing interest rates on actual performance. FASB 80, in fact, does not stipulate any acceptable method for estimating correlation. The curious result is that the OTS ruled Franklin Savings to be a failed institution over ambiguous accounting when there were no specific guidelines as to what is appropriate.

The subscriptions on the interest rate measures refer to assets (a), liabilities (l), and futures (f), and all rates are assumed to change by the same amount. MVRSA and MVRSL refer to the market value of rate-sensitive assets and rate-sensitive liabilities, respectively.

As an illustration, consider the bank balance sheet data provided for the sample bank in Exhibit 6.1 of Chapter 6. Because the bank has a positive duration gap of 1.4 years, it will see its EVE decline if interest rates rise. It thus needs to sell interest rate futures contracts in order to hedge its risk position. The short position indicates that the bank will make a profit if futures rates increase. This should at least partially offset any decline in the EVE caused by corresponding increases in cash rates. Assuming the bank uses a Eurodollar futures contract currently trading at 4.9 percent with duration of 0.25 years, the target MVF contracts can be obtained from applying Equation 7.4:

$$\frac{2.88 (\$900)}{(1.10)} - \frac{1.61 (\$920)}{(1.06)} + \frac{0.25 (MVF)}{(1.049)} = 0$$

or  $MVF = -\$4,024.36$ . This suggests that the bank should sell four Eurodollar futures contracts. If all interest rates increased by 1 percent, the profit on the four futures contracts would total \$10,000 ( $4 \times 100 \times \$25$ ), or \$2,000 less than the decrease in EVE associated with the increase in cash rates (see Exhibit 6.2). The discrepancy derives from using interest rate averages and a discrete number of futures contracts. The concept, however, is clear. Duration gap mismatches can be hedged through the use of futures without dramatic changes in the portfolio.

### ACCOUNTING REQUIREMENTS AND TAX IMPLICATIONS

Regulators generally limit banks to using futures for hedging purposes. However, if a bank has a dealer operation, it can use futures as part of its trading activities. Regardless of how futures contracts are used, recently imposed accounting standards require that gains and losses on futures and other off-balance sheet positions be marked-to-market as they accrue, thereby affecting current income. Such current recognition of gains or losses clearly increases the volatility of reported earnings over short intervals. For hedging applications, futures contracts must be recognized on a micro basis by linking each contract to a specific cash instrument.

To qualify as a hedge, the use of futures must meet several criteria. A bank must show that a cash transaction exposes it to interest rate risk, a futures contract must lower the bank's risk exposure, and the bank must designate the contract as a hedge. The primary difficulty involves determining whether futures reduce bank risk. Financial Accounting Standards Board statement number 80 states that this condition is met if the correlation between price

changes in futures and the hedged instrument is high. Unfortunately, there are no well-defined rules for establishing what time period should be used to calculate the correlation or even what amount of correlation is high enough. If a high correlation does not prevail, a bank must immediately stop deferring futures gains and losses and account for the proceeds as current income. As described in the Contemporary Issues Box: “Hedge Accounting and the Failure of Franklin Savings,” how regulators calculate correlation can have a profound impact on the financial statements and thus regulatory viability of a futures user. In this instance, Franklin Savings failed, in part because it recorded losses differently than the regulators and courts eventually felt was appropriate.

The tax treatment of futures contracts has undergone a broad transition. Prior to 1981, futures profits were taxed as ordinary income or capital gains, depending on the length of the trader’s holding period. Tax payments were due in the year the futures position was offset. This enabled futures traders to spread contracts by taking opposite positions in different contracts, where one produced a loss and the other a gain for similar interest rate movements. At the end of the tax year, traders would take the loss to reduce taxes and defer gains. In 1981, speculative traders were required to mark contract values to market at the end of the tax year and pay the obligated taxes in that year. Finally, the Tax Reform Act of 1986 eliminated the lower tax rate on long-term capital gains. Thus, all futures profits are taxed as ordinary income.

## USING FORWARD RATE AGREEMENTS TO MANAGE RATE RISK

The previous discussion briefly introduced forward contracts and compared their features with financial futures. While there are similarities, forward contracts differ because they are negotiated between counterparties, there is no daily settlement or marking-to-market, and no exchange guarantees performance. In general, the buyer of a forward contract agrees to pay a specific amount at a set date in the future (settlement date) for an agreed-upon asset, currency, and so on, from the counterparty representing the seller. The specified price or rate is labeled the exercise price (rate). The seller of a forward contract agrees to deliver the agreed-upon asset, currency, etc., for the specific amount at a set date when there is physical delivery. When a forward contract is cash-settled, the buyer and seller agree to exchange the difference between the exercise price and cash price at the future settlement date.

A forward rate agreement (FRA) is a type of forward contract based on interest rates. The two counterparties to an FRA agree to a **notional principal** amount that serves as a reference figure in determining cash flows. The term *notional* refers to the condition that the principal does not change hands, but is only used to calculate the value of interest payments. The buyer of the FRA agrees to pay a fixed-rate coupon payment and receive a floating-rate payment against the notional principal at some specified future date, while the seller of the FRA agrees to pay a floating-rate payment and receive the fixed-rate payment against the same notional principal. In most cases, the exercise rate is set equal to the forward rate from the prevailing yield curve reflecting the expected future interest rate. Thus, a buyer or seller of the FRA will receive cash or make cash payment only if the actual interest rate at settlement differs from that initially expected.

FRAs can be used to manage interest rate risk in the same manner as financial futures. The buyer of the FRA will receive (pay) cash when the actual interest rate at contract settlement is greater (less) than the exercise rate set at origination of the contract. The seller of the FRA will receive (pay) cash when the actual interest rate at settlement is less (greater) than the exercise rate. Note that FRAs are cash-settled at the settlement date with no interim cash flows. They are not marked-to-market and there are no margin requirements.

### FORWARD RATE AGREEMENTS: AN EXAMPLE

Suppose that Metro Bank as seller enters into a receive fixed-rate/pay floating-rate FRA agreement with County Bank as buyer with a 6-month maturity based on a \$1 million notional principal amount. The floating rate is 3-month LIBOR and the fixed (exercise) rate is 7 percent. Metro Bank would refer to this as a “3 versus 6” FRA at 7 percent on a \$1 million notional amount from County Bank. The phrase “3 versus 6” refers to a 3-month interest rate observed three months from the present, for a security with a maturity date six months from the present. The only cash flow will be determined in six months at contract maturity by comparing the prevailing 3-month LIBOR with 7 percent.

Assume, for example, that in three months 3-month LIBOR equals 8 percent. In this case, County Bank would receive from Metro Bank \$2,451. The interest settlement amount is \$2,500 determined as:

$$\text{Interest} = (.08 - .07)(90/360)\$1,000,000 = \$2,500$$

Because this represents interest that would be paid three months later at maturity of the instrument, the actual payment is discounted at the prevailing 3-month LIBOR:

$$\text{Actual interest} = \$2,500/[1 + (90/360).08] = \$2,451$$

Suppose, instead, that LIBOR equals 5 percent in three months. Here, County Bank would pay Metro Bank:

$$\text{Interest} = (.07 - .05)(90/360)\$1,000,000 = \$5,000$$

or

$$\$5,000/[1 + (90/360).05] = \$4,938$$

In this example, County Bank would pay fixed-rate/receive floating-rate as a hedge if it was exposed to loss in a rising rate environment. This is analogous to a short futures position. Metro Bank would take its position as a hedge if it was exposed to loss in a falling (relative to forward rate) rate environment. This is analogous to a long futures position.

### POTENTIAL PROBLEMS WITH FRAs

While FRAs offer some attractive features, there are several problems with using them in practice. First, like all forward contracts, FRAs are essentially credit instruments. This arises from the possibility that you might not be paid when the counterparty owes you cash. There is no clearinghouse to guarantee performance and no daily marking-to-market or collateral that is posted. In the past, some counterparties have reneged on forward contracts, so each participant must gauge carefully the reputation and soundness of its counterparties. Second, it is sometimes difficult to find a specific counterparty that wants to take exactly the opposite position. Because every FRA is negotiated, the parties might want different notional principal amounts or have a different settlement date. Thus, transactions costs can be large. Finally, FRAs are not as liquid as many alternatives. If a party to an FRA wants to exit the position prior to settlement, it might assign the contract to another party. But this requires that some compensation be paid. If the counterparty agrees, it might directly cancel the agreement for a fee. Alternatively, it might take exactly the opposite position with the counterparty if available, and lose only the change in price between origination of the FRA and the exit date.

## BASIC INTEREST RATE SWAPS AS A RISK MANAGEMENT TOOL

Interest rate swaps originated in the Eurobond market in 1980, but have recently been one of the fastest growing off-balance sheet contracts in the world. Basic interest rate swaps are now widely used by financial institutions as hedging tools and as a means of creating synthetic balance sheet positions. This section documents the nature of swap transactions and demonstrates how financial institutions use them as a risk management tool.

### CHARACTERISTICS

A **basic**, or **plain vanilla**, interest rate swap is an agreement between two parties to exchange a series of cash flows based on a specified notional principal amount. One party makes payments based on a fixed interest rate and receives floating-rate payments, while the other party makes the floating-rate payments and receives the fixed-rate payments. The fixed rate is typically based on prevailing Treasury note and bond rates and is quoted on a semiannual bond equivalent basis assuming a 365-day year. The floating rate is typically quoted on a money market basis assuming a 360-day year. These rates are applied against the notional principal amount that is constant over the life of the swap.<sup>11</sup> Maturities range from 6 months to 30 years, with most swaps in the 1- to 10-year range. In most swap transactions, a swap dealer makes a market in basic swaps and thus serves as an intermediary. As such, any party that wants to take a position can sign a master agreement with a swap dealer, which indicates the nature of the payment calculations, collateral requirements, and so on. The dealer takes the other side of the position. Thus, all transactions are effected through the dealer and any risks are manifested via the dealer's operations.

Exhibit 7.8 demonstrates how swap rates are quoted by a swap dealer. These data apply to basic interest rate swaps with 3-month LIBOR as the floating rate for all contracts. This means that all swap parties either pay or receive 3-month LIBOR versus a fixed rate that differs based on maturity. The first column indicates the term or maturity of the basic swap contract. The second column lists the prevailing U.S. Treasury spot rate with the same maturity as that for the swap. The third column represents the dealer's bid-offer spread relative to the prevailing Treasury rate. The final two columns provide the fixed rates for the different maturity swaps. The "bid" rates indicate the fixed rate that a swap party will receive if it pays 3-month LIBOR. The "offer" rates indicate the fixed rate that a swap party will pay if it receives 3-month LIBOR. The difference between the two represents the dealer's spread or profit potential.

<sup>11</sup>Amortizing and accreting swaps are available where the notional principal amount decreases and increases, respectively, over time.

**EXHIBIT  
7.8**

Interest Rate Swap Dealer Quotes for Basic Swaps: Fixed-rate Versus 3-Month LIBOR, March 10, 2005

Term	U.S. Treasuries (%)	Swap Spreads (%) (Mid-Point)	Swap Rates (%)	
			Bid	Offer
2 years	3.63	41.5	4.04	4.05
3 years	3.72	46.5	4.18	4.19
4 years	3.81	50.5	4.30	4.33
5 years	4.00	53.5	4.52	4.55
7 years	4.16	56.5	4.71	4.74
10 years	4.40	59.0	4.87	4.91
20 years	4.51	64.0	5.13	5.16
30 years	4.58	65.0	5.20	5.26

This example emphasizes the role of an intermediary in processing swaps. This intermediary may simply serve as an agent with no credit risk exposure, or as a dealer where it is a counterparty to each side of the transaction. As a dealer, the intermediary may enter into contracts without negotiating the other side of the swap and thus accept the risk of adverse rate changes. If it lays off the exposure to another counterparty, it hopes to earn the bid-offer spread. The intermediary's continuing role is to collect the interest payments and pay the difference to either party, depending on the contractual terms and the applicable interest rates. Today, many large commercial banks, investment banks, and Federal Home Loan Banks serve as intermediaries.

Conceptually, a basic interest rate swap is a package of FRAs. As with FRAs, swap payments are netted and the notional principal never changes hands. Consider the following example using data for a 2-year swap from Exhibit 7.8 based on 3-month LIBOR as the floating rate. This swap involves eight quarterly payments. Party FIX agrees to pay a fixed rate and Party FLT agrees to receive a fixed rate with cash flows calculated against a \$10 million notional principal amount. The following rates apply:

Party FIX:	Pay: 4.05%	Receive: 3-month LIBOR
Party FLT:	Pay: 3-month LIBOR	Receive: 4.04%

Exhibit 7.9 presents a time line with the expected cash flows from these two positions. Note that there are eight valuation dates representing the eight successive 3-month periods. Suppose that 3-month LIBOR for the first pricing interval equals 3 percent and there are 91 days in the 3-month period. The fixed payment for Party FIX is \$100,973 and the floating rate receipt is \$75,833 as calculated at the bottom of the exhibit. With netting and the swap dealer as the counterparty, Party FIX will have to pay the dealer the difference of \$25,140. Assuming that Party FLT took the other side of this swap through the dealer, its floating-rate payment is \$75,833 while its fixed-rate receipt is \$100,723. Thus, Party FLT will receive the difference of \$24,890 from the swap dealer. Of course, the dealer will net \$250 from the spread, which will be constant across all floating-rate changes as long as the two parties meet the swap terms. At the second and subsequent pricing intervals, only the applicable LIBOR is not known. As LIBOR changes, the amount that both Party FIX and Party FLT either pay or receive will change. We will discuss more about swap pricing later, but note for now that Party FIX will only receive cash at any pricing interval if 3-month LIBOR exceeds 4.05 percent. Party FLT will similarly receive cash as long as 3-month LIBOR is less than 4.04 percent. This emphasizes that the swap is a series of FRAs with each valuation date representing a distinct FRA with a different maturity.

Swaps represent another means for firms facing mismatched assets and liabilities to microhedge or macrohedge, or for firms that want to increase risk to adjust their earnings sensitivity in the desired way. Initially, only firms involved in the international money and capital markets used swaps, and virtually all transactions were priced in terms of LIBOR. More recently, medium-sized firms with only domestic operations have begun using swaps with many different rates—Wall Street prime, the federal funds rate, commercial paper rate, and T-bill rate—used to determine the underlying floating-rate payment obligations.

In its classic form, a plain vanilla swap arose when two firms faced substantially different interest rate risk over the same period. One firm was a high-quality borrower while the other exhibited greater perceived default risk. An interest rate swap was structured to take advantage of the perceived credit-quality differences by using the high-quality borrower's reputation to lower each firm's borrowing cost and provide the preferred type of fixed-rate or

**EXHIBIT  
7.9**

## Cash Flows Associated with Basic Interest Rate Swap Positions

**Two-Year Maturity, \$10 Million Notional Principal  
with Eight Quarterly Swap Payments****FIX: Pay 4.05 Percent, Receive LIBOR****FLT: Pay LIBOR, Receive 4.05 Percent**

	0	1	2	3	4	5	6	7	8
<i>Party FIX</i>									
Pay		\$100,973	100,973	100,973	100,973	100,973	100,973	100,973	100,973
Rec.		75,833	LIB <sub>2</sub>	LIB <sub>3</sub>	LIB <sub>4</sub>	LIB <sub>5</sub>	LIB <sub>6</sub>	LIB <sub>7</sub>	LIB <sub>8</sub>
Net		\$25,140	?	?	?	?	?	?	?
<i>Party FLT</i>									
Pay		\$75,833	LIB <sub>2</sub>	LIB <sub>3</sub>	LIB <sub>4</sub>	LIB <sub>5</sub>	LIB <sub>6</sub>	LIB <sub>7</sub>	LIB <sub>8</sub>
Rec.		100,723	100,723	100,723	100,723	100,723	100,723	100,723	100,723
Net		\$24,890	?	?	?	?	?	?	?
Dealer		\$250							
Party FIX: Period 1									
Pay:		0.0405 (91/365) \$10,000,000 =	\$100,973						
Rec:		0.0300 (91/360) \$10,000,000 =	\$75,833						
		Net Payment =	\$25,140						
Party FLT: Period 1									
Pay:		0.0300 (91/360) \$10,000,000 =	\$75,833						
Rec:		0.0404 (91/365) \$10,000,000 =	\$100,723						
		Net Receipt =	\$24,890						

NOTE: The notation LIB refers to 3-month LIBOR, with the subscript denoting the period for which the applicable floating LIBOR applies.

floating-rate financing. In today's environment, these quality spread differentials have largely disappeared with the enormous growth in swap usage.

**ADJUST THE RATE SENSITIVITY OF AN ASSET OR LIABILITY.** The most common use of basic swaps is to adjust the rate sensitivity of a specific asset or liability. This may involve making a fixed-rate loan a floating-rate loan, converting a floating-rate liability to a fixed-rate liability, and so forth. Consider a bank that makes a \$1 million, 3-year fixed-rate loan with quarterly interest at 8 percent. It finances the loan by issuing a 3-month Eurodollar deposit priced at 3-month LIBOR. The following T-account demonstrates the transaction.

Asset	Liability
Loan: \$1 million, 3-year maturity Rate: 8% fixed	3-month Eurodollar deposit: \$1 million Rate: 3-month LIBOR floating

By itself, this transaction exhibits considerable interest rate risk because the bank will see its net interest income shrink if it continues to roll over the 3-month deposit at each maturity date and LIBOR increase. The bank is liability sensitive and loses (gains) if LIBOR rises (falls). The bank can, however, use a basic swap to microhedge this transaction. Using the data from Exhibit 7.8 for a 3-year basic swap, the bank could agree to pay 4.19 percent and receive 3-month LIBOR against \$1 million for the three years. By matching this with its continuous issuance of 3-month Eurodollars after earlier ones mature, it locks in a borrowing cost of 4.19 percent because it will both receive and pay LIBOR every quarter.<sup>12</sup>

<sup>12</sup>The bank is accepting credit risk in the sense that if the market perceives that it is riskier over time and demands a risk premium on its future Eurodollar borrowings, it may pay more than 3-month LIBOR for the subsequent deposits.

**Net Effect of Balance Sheet Transaction + Swap**

Receive:	8.00% from loan + 3-month LIBOR from swap
Pay:	3-month LIBOR from Eurodollar deposit + 4.19% from swap
Net spread:	3.81%

The use of the swap enables the bank to reduce risk and lock in a spread of 3.81 percent (8.00 percent – 4.19 percent) on this transaction. The swap effectively fixed the borrowing cost at 4.19 percent for three years.

Consider another example where a bank has a commercial customer who demands a fixed-rate loan. The bank has a policy of making only floating-rate loans because it is liability sensitive and does not want to take on additional interest rate risk. Ideally, the bank wants to price the loan based on prime. Suppose that the bank makes the same \$1 million, 3-year fixed-rate loan as in the above case. It could enter into a 3-year basic swap involving prime as the floating-rate versus a fixed-rate. Assume that it enters into such a swap with a \$1 million notional principal amount, agreeing to pay a 4.19 percent fixed rate and receive prime minus 2.20 percent with quarterly payments. As indicated below, the effective interest rate received is now a floating rate equal to prime plus 161 basis points:

	<b>Loan</b>	<b>Basic Swap</b>
Receive:	8.00%	Prime – 2.20%
Pay:		4.56%
Net receipt:	Prime + (8.00% – 2.20% – 4.19%) or Prime + 1.61%	

This swap effectively converts a fixed-rate loan into a loan with a rate that floats with the prime rate.

**CREATE A SYNTHETIC SECURITY.** Some financial institutions view basic interest rate swaps as synthetic securities. As such, they enter into a swap contract that essentially replicates the net cash flows from a balance sheet transaction. For example, suppose that a bank buys a 3-year Treasury yielding 3.72 percent (from Exhibit 7.8), which it finances by issuing a 3-month deposit. This bank is liability sensitive in that it will see its net interest income from this combined trade fall if the cost of the 3-month deposit rises over time. Many banks effectively finance securities with such deposits.

Consider, as an alternative, simply entering into a 3-month swap agreeing to pay 3-month LIBOR and receive a fixed rate. Per the data in Exhibit 7.8, the fixed swap rate is 4.18 percent or 46 basis points above the 3-year Treasury rate. Interestingly, the swap produces a larger spread than the balance sheet transaction, yet has essentially the same interest rate risk profile. Why would management consider the balance sheet transaction as lower risk than the off-balance sheet swap? It does have to hold capital against the swap, albeit at a low percentage, and does not have to hold capital against the balance sheet position because it owns a zero-risk class asset.<sup>13</sup> If it no longer wanted to assume the risk, it also has the flexibility to alter its debt financing on-balance sheet at any time, and could reduce risk by issuing a longer-term deposit that matched the remaining maturity of the Treasury. Of course, the spread it earned afterward could be far different from that initially available. In contrast, it would have to exit the swap by selling its position, which might involve taking a loss. Management must determine whether the yield advantage of the swap outweighs these risks and costs.

**MACROHEDGE.** Banks can also use interest rate swaps to hedge their aggregate risk exposure measured by earnings and MVE sensitivity. The analysis is analogous to that with financial futures. Specifically, a bank that is liability sensitive or has a positive duration gap will take a basic swap position that potentially produces profits when rates increase. With a basic swap, this means paying a fixed rate and receiving a floating rate. Any profits can be used to offset losses from lost net interest income or declining EVE. This would have a comparable impact as shorting financial futures. In terms of GAP analysis, a liability-sensitive bank has more rate-sensitive liabilities than rate-sensitive assets (GAP < 0 indicates RSAs < RSLs). To hedge, the bank needs the equivalent of more RSAs. A swap that pays fixed and receives floating is comparable to increasing RSAs relative to RSLs because the receipt floats (reprices) with rate changes.

Similarly, any bank that is asset-sensitive or has a negative duration gap and wants to hedge will take a swap position that potentially produces profits when rates fall. With a basic swap, this means paying a floating rate and receiving a fixed rate. If rates fall, net interest income and EVE will fall, but the swap would likely produce a gain to offset at least part of the loss. This would have the same impact as going long on financial futures. In terms of GAP analysis, an asset-sensitive bank has more rate-sensitive assets than rate-sensitive liabilities (RSAs > RSLs). To hedge, the bank needs the equivalent of more RSLs. A swap that pays a floating rate and receives a fixed rate is comparable in impact to increasing RSLs relative to RSAs.

Many banks report their aggregate use of interest rate swaps in their rate-sensitivity reports, and thus the aggregate impact on the banks' overall interest rate sensitivity. Such treatment allows the analyst to assess, in general,

<sup>13</sup>Risk-based capital requirements for banks are introduced in Chapter 9. Generally, banks are not required to hold capital against cash and Treasury securities that have no default risk.

whether management uses swaps to increase or decrease overall risk. Consider the data for ABC bank from Exhibit 5.7 in Chapter 5, which presents the rate sensitivity report for year-end 2005. Note the data in the third row from the bottom of the exhibit titled “Swaps: Pay Fixed/Receive Floating.” These data are summary figures that indicate the aggregate impact of ABC Bank’s use of swaps across different time intervals. Under the column of rate-sensitive assets and liabilities for three months or less, the figure is \$50,000. To determine what this figure represents, note that the bank’s periodic GAP for this interval prior to the swaps’ impact would have equaled  $-\$70,252$  ( $\$278,748 - \$349,000$ ). After the swaps, the periodic GAP was  $-\$20,252$ . Thus, the swaps had the equivalent effect of adding \$50,000 in rate-sensitive assets within this time interval. Conceptually, ABC paid a fixed rate and received a floating rate on a \$50,000 notional principal to move the periodic GAP over this interval closer to zero so that the use of swaps represented a macrohedge. The corresponding impact from one to three years and three to five years also represented a hedge.

At the end of the chapter there is a problem in which you are expected to analyze the rate-sensitivity report of AmSouth at year-end 2004. For this bank, the effect of interest rate swaps is negative through each time interval: 31–90 days, 91–180 days, and 181–365 days. In each interval, swaps make the bank’s periodic GAP more negative. In the aggregate, swaps make a liability-sensitive bank more liability sensitive, such that its interest rate risk increases as measured by GAP, after the use of swaps.

### PRICING BASIC SWAPS

The pricing of basic interest rate swaps is straightforward. Consider the time line in Exhibit 7.9. The floating rate, such as 3-month LIBOR in the example, is based on some predetermined money market rate or index. The payment frequency is coincidentally set at every six months, three months, or one month, and is generally matched with the money market rate. The fixed rate is set at a spread above the comparable maturity Treasury note rate. For swap maturities out to five years, the swap or dealer spread is priced based on the implied yields on a strip of Eurodollar futures contracts for the same maturities. Beyond five years, the swap or dealer spread is priced based on risk premiums associated with matched maturity/duration corporate notes and bonds. These conventions are widely recognized, which makes the valuation of swaps straightforward.

For example, the earlier discussion assumed that the applicable LIBOR for the first pricing date three months from the present in Exhibit 7.9 was 3 percent, which equals the current 3-month LIBOR rate. The implied 3-month LIBOR yield for the second pricing date, six months from the present (LIB<sub>2</sub>), would be the futures rate on a 3-month Eurodollar futures contract that expires three months from the present. The other implied 3-month LIBOR rates (LIB<sub>3</sub>, LIB<sub>4</sub>, etc.) are similarly assumed to be the subsequent 3-month Eurodollar futures rates that represent successive futures expiration dates. In terms of Exhibit 7.9, Party FIX and Party FLT presumably did not know what LIBOR would be on these valuation dates. Neither would enter into the contract if it expected, a priori, to lose on the transaction. The implication is that a basic swap is priced as a zero net present value transaction. This means that after substituting in an expected value for LIBOR at each of the eight valuation dates, the present value of the net cash flows (netted payments and receipts) must equal zero. In essence, the fixed rate that is quoted to each party (actually, the midpoint of the two fixed rates), represents the rate that produces a zero net present value for the assumed net cash flows. Given the expected values for LIBOR read off the matched maturity Eurodollar futures contracts, the spreads over Treasury rates are determined as the markups necessary to make a swap’s net present value equal zero.

### COMPARING FINANCIAL FUTURES, FRAs, AND BASIC SWAPS

There are many similarities among interest rate swaps, financial futures, and FRAs. Each different contract enables a party to enter an agreement, which provides for cash receipts or cash payments depending on how interest rates move. Each allows managers to alter a bank’s interest rate risk exposure. None requires much of an initial cash commitment to take a position. The following table compares the positions with specific objectives:

Objective	Position	
	Financial Futures	FRAs & Basic Swaps
Profit if rates rise	Sell futures	Pay fixed, receive floating
Profit if rates fall	Buy futures	Pay floating, receive fixed

There are also several key differences. First, financial futures are standardized contracts based on fixed principal amounts. Parties negotiate the notional principal amount with FRAs and interest rate swaps. Financial futures require daily marking-to-market, which is not required with FRAs and swaps. This exposes futures participants to some risk and liquidity requirements that FRAs and swaps avoid. Many futures contracts cannot be traded out more than 3 to 4 years, while interest rate swaps often extend 10 to 30 years. The market for FRAs is not that liquid and most contracts are short term. Historically, trading activity was much deeper with futures such that liquidity, especially for the nearby contracts, was far greater. Swap activity has recently grown to where participants can readily buy and sell swaps in a secondary market and thus exit a position when needed. This is especially true

because of the consensus on how to value basic swaps using Eurodollar futures rates. Finally, swap documentation is quite standardized and participating firms can negotiate master agreements with partners that enhance the development of long-term business relationships.

### THE RISK WITH SWAPS

While interest swaps are an alternative to futures and FRAs, they also entail risks. The recent experience of savings and loans is an example. When interest rates increased sharply during the early 1980s, many thrifts took advantage of interest rate swaps to obtain fixed-rate financing. When mortgage rates averaged 13 to 14 percent, it seemed reasonable to fix borrowing costs at 11 percent. Unfortunately for these swap players, the level of interest rates moved dramatically lower in the mid-1980s. Had thrifts waited, they could have paid much lower rates on both fixed-rate and floating-rate debt. Thus, they locked in much higher fixed interest expense for the benefit of risk reduction. The problems were compounded as homeowners took advantage of the lower rates to refinance their mortgages. In many instances, thrifts lost their high yielding, fixed-rate assets via prepayments but kept their fixed-rate interest obligations. Selling the swap obligations to a third party prior to expiration would have produced a direct income statement loss.

Similar problems arose with Long-Term Capital Management's use of swaps in 1998. This hedge fund made speculative bets that different interest rates would converge (equal the same value) over time. Because they were confident in their bet, management used swaps to increase the leverage of their position. When interest rates subsequently moved in different directions, losses on the swaps and other positions virtually depleted the firm's capital and it had to be bailed out by a consortium of financial institutions.

Market participants have developed a secondary market for swaps to reduce a firm's exposure to swap positions that it might want to exit. Straightforward plain vanilla swaps follow a standardized format stipulated by terms of the International Swap Dealers Agreement such that positions can be quickly entered and exited. The standardized features have made it easy to trade these swaps in the secondary market. Unfortunately, the more complicated is a swap, the more difficult it is to trade the swap in the secondary market. Each swap is a negotiated contract between two parties. When the terms are unusual, the attractiveness decreases in the secondary market because the buyer must carefully analyze and price the unusual features of the underlying swap. Without guarantees or easily identifiable default risk, the liquidity of swaps diminishes. Such swaps, particularly those with options and other nonstandardized terms, are not as readily marketable.

There is some credit risk with swaps as well, but this is not as great for a single contract as it originally seems. Remember that swap parties exchange only net interest payments. The notional principal amount never changes hands, such that a party will not lose that amount. Credit risk exists because the counterparty to a swap contract may default. This is a problem when interest rates have moved against the counterparty and you are owed money. Suppose that you have agreed to pay LIBOR and receive 7 percent with semiannual payments for three years. If LIBOR is above 7 percent, you must pay the counterparty such that the counterparty owes you nothing. The counterparty is concerned with your ability to pay. You accept counterparty risk when LIBOR is below 7 percent. This risk is generally associated with the swap dealer's credit standing. When either counterparty perceives that there is a meaningful probability that the other counterparty may not perform under a swap, it will require collateral in support of the swap position. The existence and value of the collateral, in turn, affect the prices that intermediaries charge for making a market in swaps. These collateral arrangements are commonly part of bilateral collateral agreements that counterparties sign when they enter the swap market. The value of the required collateral, in turn, often rises and falls with changes in the ongoing (mark-to-market) value of the swap position.

Counterparty risk is extremely important to swap participants. Firms that are actively engaged in swap transactions often limit the amount of swap business they will do with any single counterparty to limit their risk exposure. Banks should have such policy limits approved by the board of directors before entering into swap contracts.

## INTEREST RATE CAPS AND FLOORS

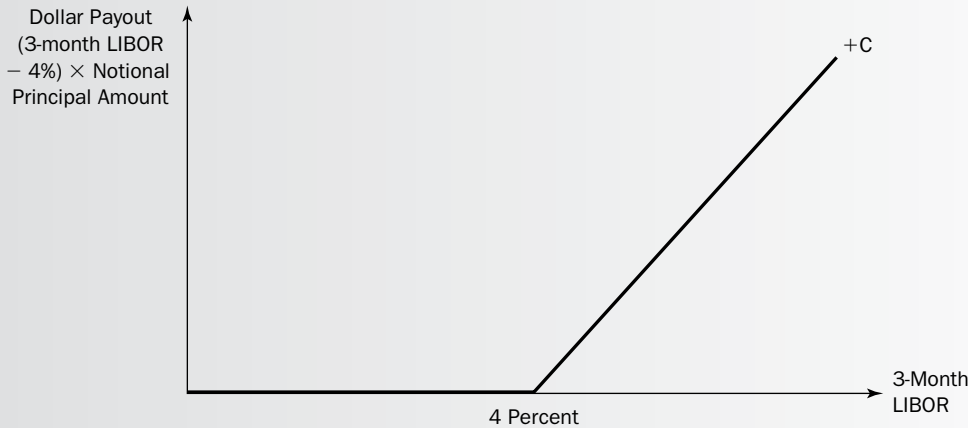
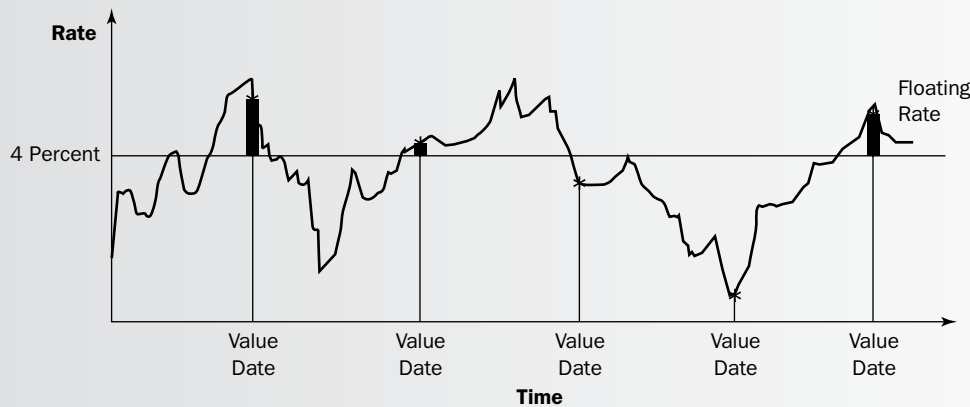
In addition to futures, FRAs and swaps, banks can hedge interest rate exposure through the use of caps and floors on interest rates. Caps and floors are options on interest rates such that participants either buy the option or sell the option. The appropriate position depends on the nature of the risk exposure the bank wants to hedge, or its speculative bet on future interest rate movements.

### BUYING AN INTEREST RATE CAP

An **interest rate cap** is an agreement between two counterparties that limits the buyer's interest rate exposure to a maximum rate. An **interest rate floor** is an agreement between two counterparties that limits the buyer's interest rate exposure to a minimum rate. Buying a cap is actually the purchase of a call option on an interest rate. Buying a floor is actually the purchase of a put option on an interest rate.

**EXHIBIT  
7.10**

Buying a Cap on 3-Month LIBOR at 4 Percent

**A. Cap = Long Call Option on 3-Month LIBOR****B. Cap Payoff: Strike Rate = 4 Percent\***

\*Payoff at Value Date equals prevailing (LIBOR – 4 percent) × Notional Principal Amount.

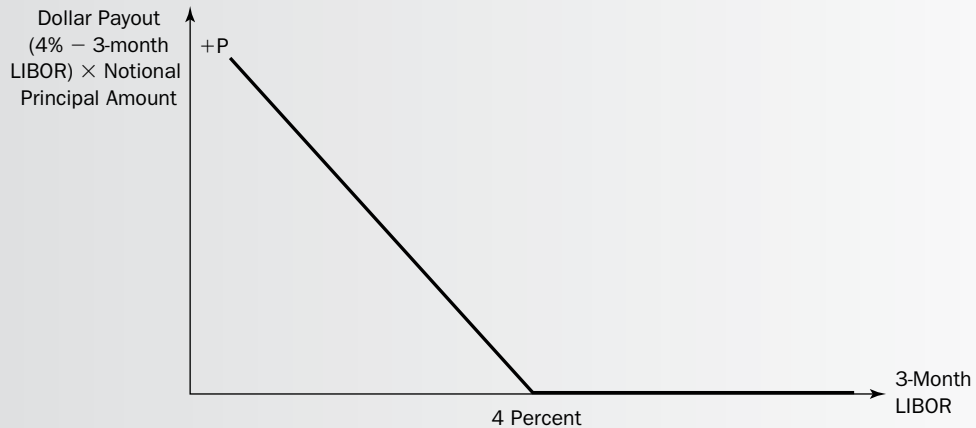
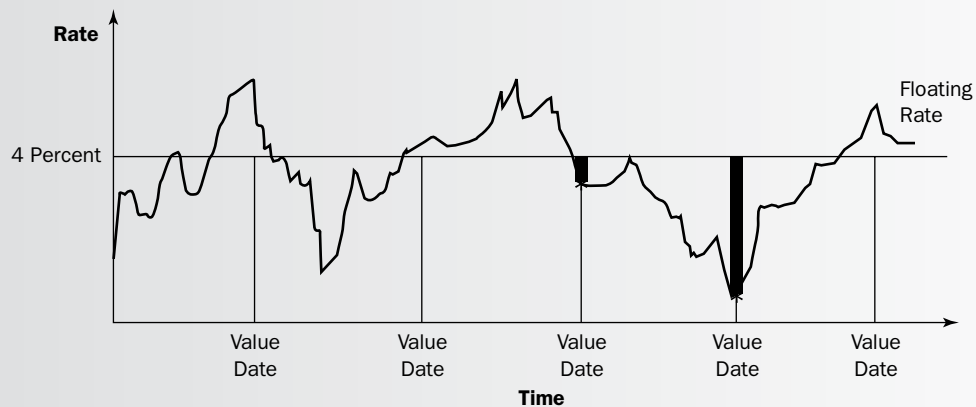
When trading interest rate caps or floors, a participant selects a floating-rate index, a term to maturity, a strike (exercise) rate, the frequency of value dates when cash payments are made, and a notional principal amount. Depending on prevailing economic conditions these choices determine the price (premium) at which the option trades.

Consider the two diagrams in Exhibit 7.10. Section A characterizes the payoff diagram for the purchase of a 4 percent cap on 3-month LIBOR. It is the same as a long call option position.<sup>14</sup> An interest rate cap has a maturity and periodic valuation dates, a notional principal amount, and a strike rate that is based on some reference interest rate. The buyer of a cap pays a one-time up-front premium and receives a cash payment from the seller of the cap equal to 3-month LIBOR minus 4 percent multiplied by some notional principal amount on each valuation date, with no payment made if LIBOR is below 4 percent. Formally, the payoff is the maximum of zero or 3-month LIBOR minus 4 percent times the notional principal amount. Thus, if 3-month LIBOR exceeds 4 percent, the buyer receives cash from the seller, and nothing otherwise. At maturity, the cap expires. These payoffs are indicated in Section B of Exhibit 7.10.

<sup>14</sup>Formally, a single call option on an interest rate is referred to as a caplet. An interest rate cap is actually a series of caplets at the same strike rate.

**EXHIBIT  
7.11**

Buying a Floor on 3-Month LIBOR at 4 Percent

**A. Floor = Long Put Option on 3-Month LIBOR****B. Floor Payoff: Strike Rate = 4 Percent\***

\*Payoff at Value Date equals prevailing (4 percent - LIBOR)  $\times$  Notional Principal Amount.

Consider a cap on 3-month LIBOR at 4 percent based on a \$100 million notional principal amount. If LIBOR equals 4.63 percent on the first valuation date and ignoring compounding, the buyer would receive \$157,500 ( $0.0063/4 \times \$100$  million) from the cap seller. If LIBOR is 3.95 percent on the second valuation date, the buyer would receive zero. The obligated payment is a rate differential times the notional principal amount, or zero.

An **interest rate cap** is a series of consecutive long call options (caplets) on a specific interest rate at the same strike rate. The buyer selects an interest rate index, such as 3-month LIBOR, the prime rate, 1-month commercial paper rate, T-bill rate or the federal funds rate, a maturity over which the contract will be in place, a strike (exercise) rate that represents the cap rate, and a notional principal amount. By paying an up-front premium, the buyer then locks in this cap on the underlying interest rate.

The benefits of buying a cap are similar to those of buying any option. The bank as buyer of a cap can set a maximum (cap) rate on its borrowing costs. It can also convert a fixed-rate loan to a floating-rate loan. In this context, it gets protection from increasing rates and retains the benefits if rates fall. The primary negative to the buyer is that a cap requires an up-front premium payment. If the buyer wants a cap that is at the money or in the money in a rising rate environment, the premium can be high.

**BUYING AN INTEREST RATE FLOOR**

A buyer can also establish a minimum interest rate by buying a floor on an interest rate index. Consider the diagrams in Exhibit 7.11. Section A presents the payoff diagram for buying a 4 percent floor on 3-month

LIBOR.<sup>15</sup> Note that the diagram is similar to that for a long put option position. As indicated, the buyer of the floor receives a cash payment equal to the greater of zero or the product of 4 percent minus 3-month LIBOR and a notional principal amount. Thus, if 3-month LIBOR exceeds 4 percent, the buyer of a floor at 4 percent receives nothing. The buyer is paid only if 3-month LIBOR is less than 4 percent. This payoff pattern is indicated in Section B of Exhibit 7.11.

An interest rate floor is a series of consecutive floorlets at the same strike rate. The buyer of an interest rate floor selects an index, with LIBOR, the prime rate, commercial paper rate, T-bill rate, and federal funds rate again the most popular; a maturity for the agreement, a strike rate, and a notional principal amount. By paying a premium, the buyer of the floor, or series of floorlets, has established a minimum rate on its interest rate exposure. The benefits are again those of any long option. A floor protects against falling interest rates while retaining the benefits of rising rates. The primary negative is that the premium may be high on an at the money or in the money floor, especially if the consensus forecast is that interest rates will fall in the future.

### INTEREST RATE COLLAR AND REVERSE COLLAR

In some cases, banks buy interest rate collars or reverse collars. The purchase of an **interest rate collar** is actually the simultaneous purchase of an interest rate cap and sale of an interest rate floor on the same index for the same maturity and notional principal amount. The cap rate is set above the floor rate. The objective of the buyer of a collar is to protect against rising interest rates. The purchase of the cap protects against rising rates while the sale of the floor generates premium income. The motivation for selling the floor is typically to provide income that reduces the cost of the cap. If the index rate rises above the cap, the buyer receives cash from the counterparty equal to the difference between the index rate and the cap (strike) rate. Of course, if the index rate falls below the floor, the collar buyer pays the counterparty the difference between the floor (strike) rate and the reference rate. With falling rates, the buyer of a collar gives up any potential gain from the hedged cash position. A collar creates a band within which the buyer's effective interest rate fluctuates. The buyer is willing to accept a minimum floor rate to reduce the cost of the cap protection or because of a strong belief that rates will rise and the view that the floor will be out of the money. A *zero cost collar* is designed to establish a collar where the buyer has no net premium payment. This requires choosing different cap and floor rates such that the premiums are equal. The benefit is the same as any collar with zero up-front cost. The negative is that the band within which the index rate fluctuates is typically small and the buyer gives up any real gain from falling rates.

A bank can also buy a *reverse collar*. This refers to buying an interest rate floor and simultaneously selling an interest rate cap. The objective is to protect the bank from falling interest rates. The buyer selects the index rate and matches the maturity and notional principal amounts for the floor and cap. The strike rates differ. If the index rate falls below the floor, the buyer of a reverse collar receives cash from the counterparty. If the index rate rises above the cap, the buyer makes cash payment to the counterparty. The motivation for selling the cap is typically to reduce the cost of buying a floor. The net result is that the buyer's interest rate fluctuates within a band. The buyer is willing to accept a maximum rate to reduce the cost of the floor or because it has a strong belief that rates will fall and the cap will be out of the money. Buyers can again construct zero cost reverse collars when it is possible to find floor and cap rates with the same premiums that provide an acceptable band.

One of the most important considerations when evaluating whether to buy caps and floors is the premium cost. Exhibit 7.12 provides summary information for the premiums on various caps and floors on 3-month LIBOR in March 2005. The top part of the exhibit provides the bid and offer premiums for caps and floors at different strike rates. The first column of data in each section indicates the term for the underlying caps and floors. Subsequent columns indicate the premiums. For the caps, the strike rates are 4, 5, and 6 percent. For the floors, the strike rates are 1.5, 2., and 2.5 percent. The bid premium represents what the option seller receives while the offer premium represents what the option buyer pays. At the time of these quotes, the cash market 3-month LIBOR equaled 3 percent. The 3-month Eurodollar futures rates in Exhibit 7.1 indicate the consensus forecast that 3-month LIBOR will rise over time.

The size of these premiums is determined by a wide range of factors. First, the relationship between the strike rate and the prevailing 3-month LIBOR indicates how much LIBOR has to move before the cap or floor is in the money. Specifically, the premiums are highest for in the money options and lower for at the money and out of the money options. With the prevailing LIBOR at 3 percent, the floor at 2.5 percent is out of the money while a floor at 3 percent is at the money. All other floors and all caps are out of the money. The premiums for the 3 percent strike rate will be the highest for the floors because it has an intrinsic value of zero basis points (3 percent strike rate – 3 percent LIBOR) and any decline in LIBOR immediately increases the expected cash receipts. LIBOR must fall considerably before the 1.5 percent floor is in the money. For the interest rate caps, the premium on the 4 percent strike rate will

<sup>15</sup>Formally, a single floor option on an interest rate is referred to as a floorlet. An interest rate floor is actually a series of floorlets at the same strike rate.

**EXHIBIT  
7.12**

## Premiums for Interest Rate Caps and Floors on 3-Month LIBOR

**A. Caps/Floors**

Term	Bid	Offer	Bid	Offer	Bid	Offer
<b>Caps</b>	<b>4.00%</b>		<b>5.00%</b>		<b>6.00%</b>	
1 year	24	30	3	7	1	2
2 years	51	57	36	43	10	15
3 years	105	115	74	84	22	29
5 years	222	240	135	150	76	5
7 years	413	433	201	324	101	116
10 years	549	573	278	308	157	197
<b>Floors</b>	<b>1.50%</b>		<b>2.00%</b>		<b>2.50%</b>	
1 year	1	2	15	19	51	55
2 years	1	6	31	37	84	91
3 years	7	16	40	49	128	137
5 years	24	39	75	88	190	205
7 years	38	60	92	106	228	250
10 years	85	115	162	192	257	287

NOTE: Caps/Floors are based on 3-month LIBOR; up-front costs in basis points. Figures in bold print represent strike rates.

be highest because LIBOR has to rise the least (100 basis points) before the buyer receives a cash payment. With higher strike rates, LIBOR has to increase sharply before the buyer will receive cash. Note, however, that the Euro-dollar futures rates in Exhibit 7.1 indicate an expected increase in rates above 4 percent in December 2005 and over 5 percent by June 2009. Second, the premiums increase with maturity. This reflects the fact that an option seller must be compensated more for committing to a fixed-rate cap or floor for a longer period of time.

Finally, prevailing economic conditions influence premiums via the shape of the associated yield curve and the volatility of interest rates. If the yield curve for Eurodollars is upsloping such that the consensus is that LIBOR will rise in the future, caps will be more expensive than floors. The steeper is the slope of the yield curve, ceteris paribus, the greater are the cap premiums. If the yield curve is flat or inverted, caps will be relatively inexpensive. Floor premiums, in contrast, reveal the opposite relationship. The steeper is the yield curve, the cheaper are floor premiums. If the yield curve is inverted, floor premiums will be relatively expensive. Like all options, the greater is the volatility of rates, the higher will be premiums because there is a greater likelihood that the options may move in the money. Finally, regardless of intrinsic value, maturity, and yield curve shape, a dealer in caps and floors will typically charge a higher premium for substantial positions in large notional principal amounts.

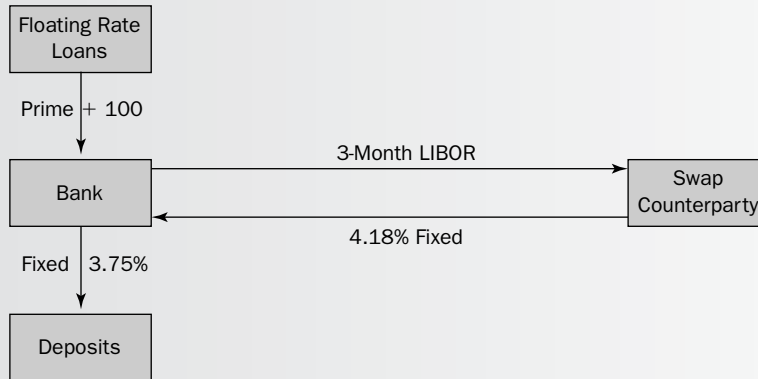
**PROTECTING AGAINST FALLING INTEREST RATES**

Assume that your bank is asset sensitive such that the bank's net interest income will decrease if interest rates fall. Essentially the bank holds loans priced at prime plus 1 percent and funds the loans with a 3-year fixed-rate deposit at 3.75 percent. The management team has a strong belief that interest rates will fall over the next three years. It is considering three alternative approaches to reduce risk associated with falling rates: 1) entering into a basic interest rate swap to pay 3-month LIBOR and receive a fixed rate; 2) buying an interest rate floor; and 3) buying a reverse collar. Exhibits 7.13, 7.14, and 7.15 summarize the net results of each position when rates alternatively fall and rise relative to the current environment. Note that initially, the bank holds assets priced based on prime and liabilities priced based on 3-month LIBOR. For this example, the two rates are assumed to be perfectly correlated.

Exhibit 7.13 compares the results using a basic interest rate swap where the bank agrees to pay 3-month LIBOR and receive 4.18 percent for a 3-year term. There are three interest rate scenarios where rates are constant and rise or fall by 1 percent. Initially, the prime rate equals 5.50 percent and LIBOR equals 3 percent, which generates a spread of 2.75 percent for the loans versus the fixed-rate deposits. With rates constant at these levels, the net cash flow from the swap produces an inflow of 118 basis points for a net interest margin of 3.93 percent, as indicated in

**EXHIBIT  
7.13**

Using a Basic Swap to Hedge Aggregate Balance Sheet Risk of Loss from Falling Rates

**Bank Swap Terms: Pay LIBOR, Receive 4.18 Percent\***

	<u>Current Rates Constant</u>	<u>Rates Fall 100 Basis Points</u>	<u>Rates Rise 100 Basis Points</u>
	PRIME 5.50%	PRIME 4.50%	PRIME 6.50%
	LIBOR 3.00%	LIBOR 2.00%	LIBOR 4.00%
<b>Balance Sheet</b>			
<b>Flows:</b>			
Loan	6.50%	5.50%	7.50%
Deposit	(3.75%)	(3.75%)	(3.75%)
Spread	2.75%	1.75%	3.75%
<b>Interest Rate</b>			
<b>Swap Flows:</b>			
Fixed	4.18%	4.18%	4.18%
Floating	(3.00%)	(2.00%)	(4.00%)
Spread	1.18%	2.18%	.18%
<b>Margin</b>	3.93%	3.93%	3.93%

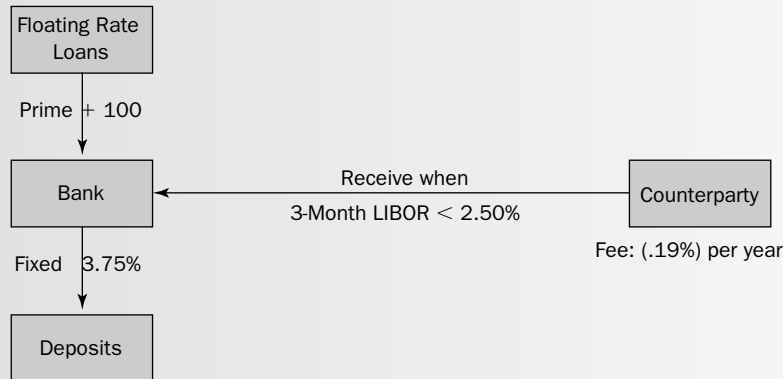
\*Assume swap term is three years and perfect correlation between PRIME and LIBOR.

the first column of data. Examine the second and third columns of data where floating rates are assumed to fall and rise from initial levels. Given the assumed perfect correlation between prime and LIBOR, this margin is constant at 3.93 percent whether rates either fall or rise by 1 percent. This occurs because any reduction in the spread when prime falls to 4.50 percent is offset by the gain on the swap as LIBOR falls to 2 percent. Similarly, any gain in spread as prime rises to 6.50 percent is offset by a reduction in the swap receipt as LIBOR rises to 4 percent. The use of the swap effectively fixed the spread near the current level, except for basis risk.

Exhibit 7.14 summarizes the outcomes from hedging by buying a floor with a 3-year maturity on 3-month LIBOR at a 2.50 strike rate. The up-front premium is 49 basis points represented by a 19 basis point annual amortization. At current interest rates indicated in the first column of data, the balance sheet interest spread is 2.75 percent, which produces a net interest margin of 2.56 percent after subtracting the 19 basis point cost of the floor premium. If rates fall 1 percent as noted in the second column of data, the spread falls to 1.75 percent, but the floor on LIBOR generates a cash receipt of 50 basis points. Thus, the net interest margin is 2.06 percent. If rates rise 1 percent as in the third column of data, the spread widens and the floor falls out of the money such that the margin increases to 3.06 percent. This demonstrates the impact of options on hedge results. If rates fall and the floor is in the money, the in-

**EXHIBIT  
7.14**

Buying a Floor on 3-Month LIBOR to Hedge Aggregate Balance Sheet Risk of Loss from Falling Rates

**Floor Terms: Buy a 2.50 Percent Floor on 3-Month LIBOR\***

	<b>Current Rates Constant</b>	<b>Rates Fall 100 Basis Points</b>	<b>Rates Rise 100 Basis Points</b>
	PRIME 5.50%	PRIME 4.50%	PRIME 6.50%
	LIBOR 3.00%	LIBOR 2.00%	LIBOR 4.00%
<b>Balance Sheet</b>			
<b>Flows:</b>			
Loan	6.50%	5.50%	7.50%
Deposit	(3.75%)	(3.75%)	(3.75%)
Spread	2.75%	1.75%	3.75%
<b>Floor Flows:</b>			
Payout	0.00%	0.50%	0.00%
Fee Amort.	(0.19%)	(0.19%)	(0.19%)
Spread	(0.19%)	0.19%	(0.19%)
<b>Margin</b>	2.56%	2.06%	3.56%

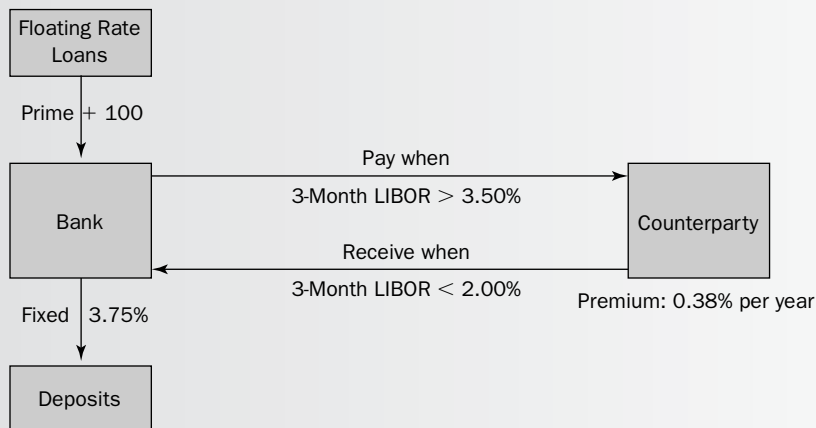
\*Assume floor term is three years and perfect correlation between PRIME and LIBOR.

crease in option value offsets the loss in the spread position. If rates rise, the option expires worthless, but the value of the cash spread increases. The bank retains benefits from rising rates. The bank is best served if cash market rates move favorably and the floor expires worthless. The floor buyer is protected when bad things (rate declines) happen, but retains the benefit of favorable (rate increases) rate movements. The buyer does not want to collect on the insurance. Note that the more rates increase, the higher is the margin for the bank. As such, there is no limit to the upside from this hedged position, unlike the swap hedge that fixed the outcome.

Exhibit 7.15 documents the outcomes from simultaneously buying a floor on 3-month LIBOR at 2 percent and selling a cap on 3-month LIBOR at 3.50 percent. This reverse collar protects the bank from falling rates but provides a band within which the effective interest margin will fluctuate. The sale of the cap generates a net premium receipt of 95 basis points up front, represented by an annual 38 basis point amortization of premium. At prevailing rates indicated in the first column of data, the net interest margin is expected to be 3.13 percent characterized by the spread plus the 38 basis point premium amortization on the reverse collar. The 1 percent drop in rates summarized in the second column of data produces a net margin of 2.63 percent, whereby the 50 basis point receipt from the floor and premium amortization total of 88 basis points and reduce the 1 percent decline in interest

**EXHIBIT  
7.15**

Buying a Reverse Collar to Hedge Aggregate Balance Sheet Risk of Loss from Falling Rates

**Strategy: Buy a Floor on 3-Month LIBOR at 2.00 Percent, and Sell a Cap on 3-Month LIBOR at 3.50 Percent\***

	<u>Current Rates Constant</u>	<u>Rates Fall 100 Basis Points</u>	<u>Rates Rise 100 Basis Points</u>
	PRIME 5.50%	PRIME 4.50%	PRIME 6.50%
	LIBOR 3.00%	LIBOR 2.00%	LIBOR 4.00%
<b>Balance Sheet</b>			
<b>Flows:</b>			
Loan	6.50%	5.50%	7.50%
Deposit	(3.75%)	(3.75%)	(3.75%)
Spread	2.75%	1.75%	3.75%
<b>Reverse Collar</b>			
<b>Flows:</b>			
Payout	0.00%	0.50%	(0.50%)
Fee Amort.	0.38%	0.38%	0.38%
Spread	0.38%	0.28%	(0.12%)
<b>Margin</b>	3.13%	2.63%	3.63%

\*Assume collar term is three years and perfect correlation between PRIME and LIBOR.

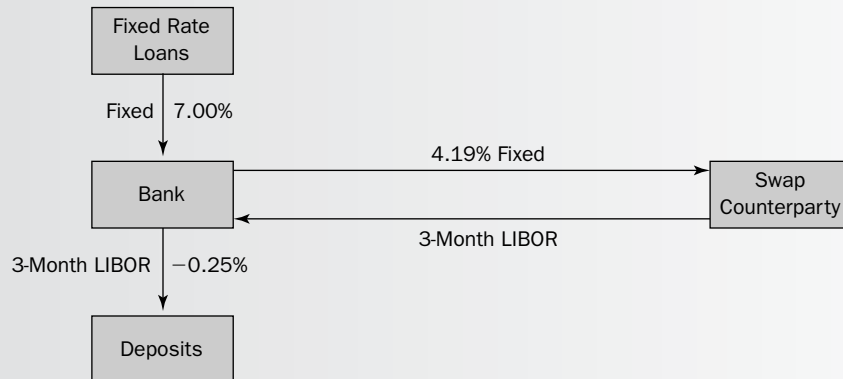
spread. When rates rise (third column of data) the spread widens, but the bank gives back part of the gain by paying 50 basis points on the cap that it sold. Given alternative rates, the bank's realized margin will fluctuate between 2.63 percent and 3.63 percent. Thus, the collar differs from a pure floor by eliminating some of the potential benefits in a rising rate environment. The bank actually receives a net premium up-front, however, rather than having to pay a premium from the outright purchase of a floor in this example.

**PROTECTING AGAINST RISING INTEREST RATES**

Assume that a bank has made 3-year fixed-rate term loans at 7 percent, funded via 3-month Eurodollar deposits for which it pays the prevailing LIBOR minus 0.25 percent. The bank is liability sensitive because it is exposed to loss from rising interest rates. Exhibits 7.16, 7.17, and 7.18 describe the results from three strategies to hedge this risk: 1) enter a basic swap to pay 4.19 percent fixed-rate and receive 3-month LIBOR; 2) buy a cap on 3-month LIBOR with a 3.50 strike rate; and 3) buy a collar on 3-month LIBOR.

**EXHIBIT  
7.16**

Using a Basic Swap to Hedge Aggregate Balance Sheet Risk of Loss From Rising Rates

**Strategy: Pay 4.19 Percent, Receive 3-Month LIBOR\***

	<u>Current Rates Constant</u>	<u>Rates Fall 100 Basis Points</u>	<u>Rates Rise 100 Basis Points</u>
<b>Balance Sheet</b>	LIBOR 3.00%	LIBOR 2.00%	LIBOR 4.00%
<b>Flows:</b>			
Loan	7.00%	7.00%	7.00%
Deposit	(2.75%)	(1.75%)	(3.75%)
Spread	4.25%	5.25%	3.25%
<b>Interest Rate Swap Flows:</b>			
Fixed	(4.19%)	(4.19%)	(4.19%)
Floating	3.00%	2.00%	4.00%
Spread	(1.19%)	(2.19%)	0.19%
<b>Margin</b>	3.06%	3.06%	3.06%

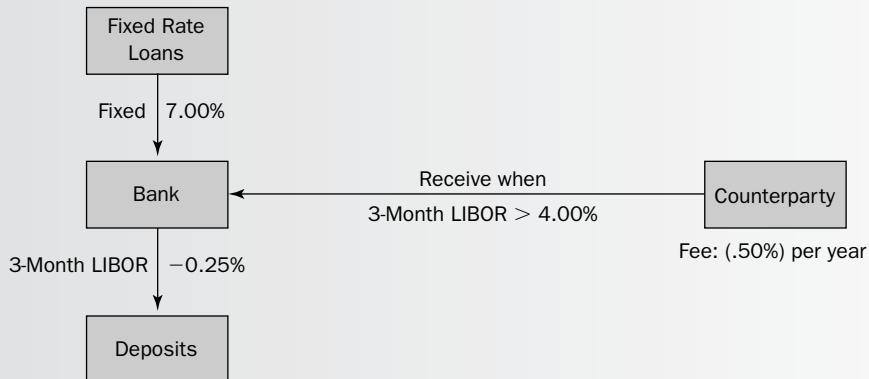
\*Assume swap term is three years.

The use of the basic swap again effectively fixes a net interest margin. As demonstrated in the first column of data in Exhibit 7.16, the initial interest spread is 4.25 percent and the bank pays 119 basis points on the swap at prevailing rates. This produces a net spread of 3.06 percent. If LIBOR falls 1 percent, as noted in the second column of data, the interest spread widens to 5.25 percent but the bank pays out 2.19 percent on the swap. If LIBOR rises 1 percent as characterized in the third column of data, the spread narrows but the bank pays just 0.19 percent on the swap. The net spread or margin is the same—3.06 percent—in all cases. Obviously, the consensus forecast is for LIBOR to rise as participants would otherwise refuse to enter this swap with such a large payout if rates remained constant.

Buying a 3.50 percent cap allows the bank to potentially benefit if rates fall, but still protects against loss if rates rise. This is demonstrated in Exhibit 7.17. With an amortized premium cost of the cap at 50 basis points, the initial net interest margin equals 3.75 percent. This is summarized in the first column of data. The subsequent columns indicate the impact if rates vary from initial levels. If rates fall by 1 percent, the net margin increases to 4.75 percent because the interest spread widens and the cap cost remains fixed at 50 basis points. Each subsequent decline in LIBOR will be matched by an increase in the margin. Thus, the bank has unlimited upside in a falling

**EXHIBIT  
7.17**

Buy a Cap on 3-Month LIBOR to Hedge Balance Sheet Rate Risk of Loss from Rising Rates

**Strategy: Buy a Cap on 3-Month LIBOR at 4.00 Percent\***

	<u>Current Rates Constant</u>	<u>Rates Fall 100 Basis Points</u>	<u>Rates Rise 100 Basis Points</u>
	LIBOR 3.00%	LIBOR 2.00%	LIBOR 4.00%
<b>Balance Sheet</b>			
<b>Flows:</b>			
Loan	7.00%	7.00%	7.00%
Deposit	(2.75%)	(1.75%)	(3.75%)
Spread	4.25%	5.25%	3.25%
<b>Cap</b>			
<b>Flows:</b>			
Payout	0.00%	0.00%	0.50%
Fee Amort.	(0.50%)	(0.50%)	(0.50%)
Spread	(0.50%)	(0.50%)	0.00%
<b>Margin</b>	3.75%	4.75%	3.25%

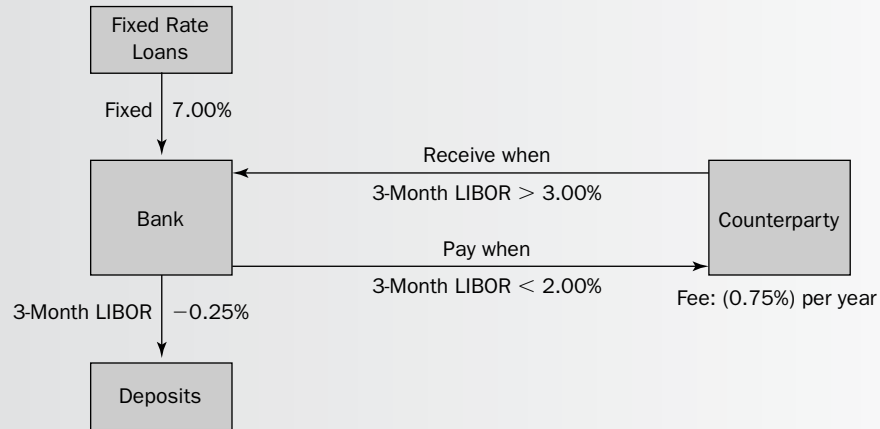
\*Assume cap term is three years.

rate environment. If LIBOR rises 1 percent (column 3), the cap goes in the money. The interest spread declines consistent with the bank's risk exposure, but the cap position generates a payoff of 50 basis points. The net margin falls to 3.25 percent.

Exhibit 7.18 presents the outcomes from buying a collar on 3-month LIBOR. The combined positions consist of buying a cap at 3 percent and simultaneously selling a floor at 2 percent. The bank thus receives cash if LIBOR rises above 3 percent, but must pay on the floor if LIBOR falls below 2 percent. This effectively creates a band within which the bank's margin will fluctuate. As noted in the three data columns of Exhibit 7.18, the band for the net spread is between 3.50 percent and 4.50 percent. The collar provides similar protection to the straight purchase of a cap, but gives up the potential benefits of falling rates because of the sale of a floor. The net margin declines with each decline in LIBOR. The cost of the collar is just 75 basis points a year rather than the 115 basis points annually for the cap. Not surprisingly, the bank is better off when rates fall and the interest spread is the greatest. It is worse off when rates rise and the spread narrows, but the cap generates a cash receipt.

**EXHIBIT  
7.18**

Using a Collar on 3-Month LIBOR to Hedge Balance Sheet Risk of Loss from Rising Rates

**Strategy: Buy a Cap at 3.00 Percent, and Sell a Floor at 2.00 Percent\***

	<u>Current Rates Constant</u>	<u>Rates Fall 100 Basis Points</u>	<u>Rates Rise 100 Basis Points</u>
	<u>LIBOR 3.00%</u>	<u>LIBOR 2.00%</u>	<u>LIBOR 4.00%</u>
<b>Balance Sheet</b>			
<b>Flows:</b>			
Loan	7.00%	7.00%	7.00%
Deposit	(2.75%)	(1.75%)	(3.75%)
Spread	4.25%	5.25%	3.25%
<b>Collar Flows:</b>			
Payout	0.00%	(0.00%)	1.00%
Fee Amort.	(0.75%)	(0.75%)	(0.75%)
Spread	(0.75%)	(0.75%)	0.25%
<b>Margin</b>	3.50%	4.50%	3.50%

\*Assume collar term is three years.

**S U M M A R Y**

Bank managers are paid to manage risk. In many cases, it is appropriate to reduce a bank's exposure to potentially adverse changes in interest rates. Hedging with financial futures contracts, forward rate agreements (FRAs), and basic interest rate swap agreements are three methods banks can use to reduce interest rate risk. The concept underlying hedging with futures is that a bank trades financial futures such that losses or gains on its actual cash transactions due to interest rate changes are at least partially offset by gains or losses on its futures position. Risk reduction occurs because the net loss or gain is typically less with a hedge than if no futures position is taken. The same applies with FRAs and interest rate swaps. A basic interest rate swap is, in fact, a package of FRAs. A bank exposed to loss on-balance sheet when rates rise or fall can trade fixed interest payments or receipts for floating interest payments or receipts that similarly offset the change in net interest income from balance sheet positions.

Thus, when net interest income declines, the FRA and swap produce a net cash receipt. When net interest income increases, the FRA and swap require a net cash payment.

Banks also manage risk through the use of interest rate caps and floors. Such contracts are options on interest rates. If the bank buys a cap or floor, it pays an up-front premium but gets insurance to protect against rising rates with caps and falling rates with floors. The primary negative with caps and floors is the explicit premium cost that must be paid up front to enter a position. Both caps and floors, however, allow a bank to benefit from favorable interest rate moves and their impact on balance sheet exposures.

Managers must determine whether they want to hedge or, alternatively, use these derivatives to speculatively increase their risk exposure. For example, some banks view swaps as synthetic securities complete with interest rate risk. When hedging, managers must decide whether to microhedge individual transactions or macrohedge a bank's aggregate interest rate risk measured by GAP and earnings sensitivity or duration gap and MVE sensitivity. The fundamental conclusion is that managers have alternatives to alter a bank's interest rate risk position other than traditional cash transactions.

### QUESTIONS

- How does a futures contract differ from a forward contract?
- It is said that a microhedge does not totally eliminate risk. Assume that a bank uses financial futures contracts to reduce the risk of rising rates on new borrowings. Identify what type of position the bank should take to hedge. Once a hedge is in place, what risks remain?
- Some analysts compare the initial margin on a futures contract to a down payment. Some label it a performance bond. What is the difference between these interpretations?
- Suppose that you are a speculator who trades 3-month Eurodollar futures. On November 5, you sell two December 3-month Eurodollar futures contracts at 94.81. The subsequent weekly quotes for the closing December Eurodollar futures price are as follows:[comp: set as table]

Date:	11/12	11/19	11/26	12/3
Price:	94.92	95.08	94.77	94.63

Calculate the weekly values in your margin account. The initial margin is \$650 per contract and the maintenance margin is \$400. Calculate your realized return for the entire period. Assume that you offset your futures position on December 3 at the price indicated.

- Suppose that you are a speculator who tries to time interest rate movements on 3-month T-bill futures contracts. Use the data in Exhibit 7.1 and assume that it is March 11, 2005, to answer the following questions.
  - What is the 3-month T-bill rate in the cash market? (Approximate it from the yield curve.) How does it differ from the June futures rate?
  - Use the data from the Treasury yield curve for 3-month and 6-month maturities to calculate the 3-month forward rate, three months after March 11, 2005.
  - Compare the forward rate you calculated from Part b with the June 2005 T-bill futures rate. Do they provide similar information? Should they provide similar information?
  - As a speculator, you expect cash T-bill rates to rise through December 2005.
    - Explain precisely what expectations are consistent with selling the June 2005 T-bill futures contract to make a profit.
    - Explain precisely what rate expectations are consistent with buying the June 2005 T-bill futures contract to make a profit.
- Explain why cross hedges generally exhibit greater risk than hedges using a futures contract based on the underlying cash instrument hedged.
- In each of the following cases, conduct the analysis for Step 1 and Step 2 in evaluating a hedge. Specifically assess cash market risk and determine whether the bank should buy or sell financial futures as a hedge. Explain how the hedge should work.
  - The bank expects to receive a large, past-due principal payment on a loan in 45 days.
  - A deposit customer notifies the bank that she will be withdrawing \$5 million in 60 days. The bank will sell a Treasury security from its investment portfolio at that time to cover the withdrawal.
  - The bank has agreed to make a 1-year fixed-rate loan at 9.5 percent. It will fund the loan by issuing four consecutive 3-month Eurodollar time deposits. It would like to lock in its borrowing costs on the Eurodollar time deposits.

- d. The bank just won a \$10 million court settlement against a supplier and will receive the payment in three months.
  - e. In order to improve the bank's capital position, management decides to issue 15-year subordinated debentures (bonds). Unfortunately, this debt offering cannot be ready for another five months.
8. A bank plans to hedge using 3-month Eurodollar futures contracts based on \$1 million in principal. Determine how many contracts the bank should trade (its hedge ratio) in the following situations.
    - a. The bank will roll over \$125 million in 6-month CDs in four months. The Eurodollar futures rate moves 1.5 times as much as the CD rate.
    - b. In three months the bank will roll over \$50 million in 1-month loans. The loan rates move 1-to-1 with Eurodollar futures rates.
    - c. In six months the bank will extend \$5 million in floating-rate loans tied to the Eurodollar cash rate. The futures and cash rates move 1-to-1.
  9. A bank that hedges with financial futures cannot completely eliminate interest rate risk. Explain what basis risk is and why it exists. Is it ever possible to eliminate basis risk?
  10. Explain how macrohedging differs from microhedging.
  11. A bank has assets of \$10 million earning an average return of 9 percent and with a weighted duration of 1.5 years. It has liabilities of \$9 million paying an average rate of 6.5 percent with a weighted duration of 3.5 years. The bank wants to construct a macrohedge to reduce interest rate risk as much as possible, and plans to trade 3-month Eurodollar futures currently trading at 8 percent.
    - a. Should the bank buy or sell Eurodollar futures?
    - b. How many futures contracts should the bank trade?
    - c. If cash interest rates rise an average of 1 percent and the Eurodollar futures rate rises by 1.10 percent, calculate how much the bank's market value of equity will change and how much the bank would earn or lose on its futures position. Was this a successful hedge?
  12. What are the risks in a forward rate agreement if you are the buyer?
  13. Assume that you want to speculate on how 6-month cash market LIBOR will move over the next year. You believe that consensus forecasts of future rates are too high. You can enter into an FRA and agree either to pay 7.25 percent and receive 6-month LIBOR, or pay 6-month LIBOR and receive 7.25 percent for delivery in one year. Explain which position you would take and why you expect to profit.
  14. It is January 1. Your firm expects to issue (borrow) 3-month Eurodollar time deposits at the beginning of February, May, August, and November in the next year. Explain what position(s) you would take today with FRAs based on 3-month LIBOR if you wanted to fully hedge your future borrowings. Why should the hedge work? What risks do you take?
  15. Discuss the role of a third-party intermediary in an interest rate swap agreement. Describe the risks assumed by the intermediary. How does the intermediary potentially profit from this activity?
  16. What features of interest rate swaps make them more or less attractive than financial futures as a risk management tool?
  17. Is there credit risk in an interest rate swap with an intermediary bank serving as the swap dealer? Describe when default losses might arise and which party is at risk. How can credit risk be reduced?
  18. A basic interest rate swap is supposedly priced as a zero net present value transaction. Explain what this means. Use the 2-year swap data from Exhibit 7.8 to demonstrate your arguments.
  19. Your firm just made a 3-year fixed-rate loan at 8.25 percent. You would like to convert this to a floating-rate loan that is priced based on 3-month LIBOR as the base rate. Explain how you could use a basic interest rate swap to accomplish this. Using the data from Exhibit 7.8, choose swap terms that convert this fixed-rate loan to a floating-rate loan and demonstrate the resulting rate you would earn on the loan from adding the swap to the loan position.
  20. Your bank is looking for the lowest cost 2-year, fixed-rate financing. It has decided to issue four consecutive 3-month Eurodollar time deposits on-balance sheet and hedge the future borrowing costs by taking positions in the market for basic interest rate swaps. What positions are appropriate? Use the data from Exhibit 7.8 to demonstrate how swaps might be used to fix the bank's borrowing cost over two years.

21. Use the data from Exhibit 7.11 to answer the following questions:
  - a. When will the buyer of a 5-year cap on 3-month LIBOR with a 5 percent strike rate expect to receive cash? What is the cap premium?
  - b. When will the buyer of a 2-year floor on 3-month LIBOR with a 2 percent strike rate expect to receive cash? What is the floor premium?
  - c. Can you construct a zero cost collar on 3-month LIBOR with a 3-year term? If not, what positions at what strike rates might produce a zero cost collar? Use approximations.
22. Explain how the outcome from using a basic interest rate swap to hedge borrowing costs will generally differ from using an interest rate cap and an interest rate collar as hedges. Why is there a difference?
23. In each of the following cases, indicate whether an interest rate cap, floor, collar, or reverse collar is an appropriate position for a hedge. Recommend a specific position.
  - a. A bank loan customer wants to borrow at a fixed 8 percent rate and the bank only lends at floating rates.
  - b. A bank has agreed to pay a large depositor a fixed 5.5 percent on balances over the next three years regardless of rate moves. The bank expects rates to fall on similar deposits over this period.
  - c. Your bank owns adjustable rate mortgages (ARMs) that are priced at 3-month LIBOR plus 2 percent. There is an annual cap on the allowable rate increase equal to a maximum of 1 percent a year. Thus, if LIBOR rises by 3 percent, the bank can raise the ARM rate just 1 percent. How can the bank effectively remove this cap?
24. Suppose that the yield curve on Eurodollars is sharply upsloping.
  - a. Will premiums on interest rate floors on 3-month LIBOR be high or low? Explain.
  - b. Will premiums on interest rate caps on 3-month LIBOR be high or low? Explain.
25. Assume that you bought an interest rate cap on 3-month LIBOR with a 4.50 percent strike rate. The current rate for 3-month LIBOR is 4.28 percent.
  - a. What will happen to the premium (value) on this cap if LIBOR rises to 5.16 percent? Explain.
  - b. What will happen to the premium (value) on this cap if LIBOR falls to 4.10 percent? Explain.
26. Your bank is asset sensitive and management wants to protect against loss from interest rate changes.
  - a. Would an interest rate cap or floor serve as a better hedge? Explain.
  - b. Would a collar or reverse collar serve as a better hedge? Explain.
  - c. Why would the bank choose a collar or reverse collar over a cap or floor, respectively? Explain.
27. Suppose that you buy an interest rate cap on 3-month LIBOR with a 2-year maturity and simultaneously sell a floor on 3-month LIBOR with a 2-year maturity. Ignore the premiums. Draw a profit diagram that indicates when you will gain and lose on the combined positions. Compare this to different basic interest rate swap and futures positions.
28. Are there margin requirements for the following positions? Explain why or why not.
  - a. Buy an interest rate cap
  - b. Sell a put option on Eurodollar futures
  - c. Sell an interest rate floor
  - d. Sell a Eurodollar futures contract

## PROBLEMS

**I. HEDGING BORROWING COSTS.** Your bank is a regular borrower in the Eurodollar market. On August 9, 2005, the head of the funds management division decides to hedge the bank's interest cost on a \$10 million 3-month Eurodollar issue scheduled for November 2005. On August 9, the bank could issue \$10 million in 3-month Eurodollars at 4.61 percent. The corresponding futures rates for 3-month Eurodollar futures contracts are 4.83 percent (December 2005), 5.01 percent (March 2006), and 5.38 percent (June 2006).

1. What is the bank's specific cash market risk on August 9, 2005? Should the bank buy or sell Eurodollar futures to hedge its borrowing costs? Explain how the hedge should work.
2. Which Eurodollar futures contract should the bank use? Explain why it is best. Assume that the bank takes the futures position that you recommend in Questions 1 and 2 above at the rate available on August 9, 2005. On November 6, 2005, the bank issues \$10 million in Eurodollars at 6.25 percent. Coincidentally, it

closes out (reverses) its futures position when the futures rate on the contract you chose equals 6.33 percent. Calculate the profit or loss on the futures trades, the opportunity gain or loss in the cash market, and the effective return or cost to the bank on its Eurodollar issue.

3. Suppose instead that interest rates declined after August 9 and the bank actually issued Eurodollars at 4.47 percent. Assuming it closed out its futures position at 4.59 percent, calculate the same profit/loss and return/cost components as above.
4. It is important to note that the prevailing futures rate at the time a hedge is initiated reflects consensus information regarding the future level of cash market rates. Explain conceptually why the effectiveness of hedging is influenced by the accuracy of the futures rate.

**II. THE BASIS.** Assume that your bank expects to receive \$5 million in funds that it will invest in Eurodollars in four months. It plans to buy five Eurodollar futures contracts as a hedge. The current 3-month Eurodollar rate equals 5.05 percent in the cash market, and the Eurodollar futures rate for the contract purchased equals 5.39 percent. The futures contract expires one week after the bank expects to receive and invest the \$5 million. Given that a hedge still encompasses basis risk, compare the basis today with what the basis will likely equal when the bank offsets its futures position as part of closing the hedge. Provide a specific forecast of the basis in four months and explain why you chose this basis. The bank should incorporate this expected basis change when estimating the effective return from the hedge. What is this expected effective return in your analysis? When will the actual return differ from what you expect?

### III. BASIC INTEREST RATE SWAPS

1. Management at your firm is considering one of the following:
  - a. Balance Sheet Transaction: Issue a 6-month CD at 5.5 percent and use the proceeds to buy a 3-year Treasury security that carries a 7.2 percent fixed rate. It will roll over (issue new 6-month CDs) when the old one matures until funding the Treasury is no longer needed.
  - b. Interest Rate Swap Transaction: Enter into a three-year basic interest rate swap where it agrees to pay 6-month LIBOR and receive a fixed 7.58 percent rate.
    1. List the advantages and disadvantages of the two alternatives versus each other.
    2. Identify the specific risks associated with each alternative.
    3. Are they both speculative?
2. Two institutions plan to issue \$10 million in debt and are negotiating an interest rate swap that will help them lower their borrowing costs and obtain the preferred type (fixed rate or floating rate) of financing. Both are comparing their balance sheet alternatives with combined balance sheet and swap opportunities. Internet Bank has a negative GAP through three years, is liability sensitive, and would like to use the debt proceeds to invest in short-term assets to reduce its interest rate risk. Brick & Mortar Bank has a positive GAP through three years, is asset sensitive, and would like to use its debt proceeds to invest in fixed-rate assets to reduce its interest rate risk. Internet Bank can borrow at an 8.7 percent fixed rate for three years or pay the prevailing 6-month LIBOR plus 0.50 percent on floating-rate debt. Brick & Mortar Bank can borrow at an 8.15 percent fixed rate for three years or the prevailing 6-month LIBOR rate plus 0.25 percent.
  - a. Explain whether and why Internet Bank needs fixed-rate or floating-rate funding to meet its objectives. Do the same for Brick & Mortar Bank.
  - b. Assume that both banks issue either 3-year fixed-rate debt or 6-month floating-rate debt on-balance sheet. They want to combine this with a basic swap to obtain the cheapest form of funding that helps reduce interest rate risk. Using the following basic swap terms, indicate what position each bank should take. Explain how and why it should meet the bank's objectives. Calculate the effective cost of borrowing that each bank ends up with.

#### Basic Swap Terms

A. Pay 8.10%	Receive 6-month LIBOR
B. Pay 6-month LIBOR	Receive 8.03%

3. A regional bank holding company recently bought a \$100 million package of mortgages that carry an average 8.5 percent yield. The holding company has established a subsidiary to manage this package. The subsidiary will finance the mortgages by selling 90-day commercial paper for which the current rate is 5.25 percent. The interest rate risk assumed by the subsidiary is evidenced by the difference in duration of

the mortgages at six years and the duration of the commercial paper at 72 days. The holding company thus decides to arrange an interest rate swap through an intermediary bank to hedge the subsidiary's interest rate risk.

- a. Should the subsidiary make floating-rate or fixed-rate payments in the swap market? Specifically, should the subsidiary pay fixed and receive floating, or pay floating and receive fixed? Use the following data to select specific swap terms. Explain why this swap should reduce the subsidiary's interest rate risk.

Pay 7.37 percent and receive floating at 3-month LIBOR  
Pay 3-month LIBOR and receive 7.24 percent

- b. At the first pricing of the swap when the subsidiary exchanges payments with the intermediary, LIBOR equals 6.95 percent. The notional principal amount is \$100 million. Calculate the subsidiary's net cash payment or receipt with the intermediary. At the second pricing, LIBOR equals 7.66 percent. Calculate the subsidiary's net cash payment or receipt with the intermediary here.
- c. What specific credit risk does the subsidiary assume in the swap you arranged? What specific credit risk does the intermediary assume? Explain by discussing when each party is at risk that it will lose if the counterparty defaults.

**IV. AMSOUTH SENSITIVITY ANALYSIS: 2004.** Data for AmSouth's rate sensitivity at year-end 2004 is provided on the following page. Use the information to answer the following questions.

- Toward the bottom of the table, a row of data indicates the effect of interest rate swaps. Did the bank's swap activity increase or decrease the bank's risk exposure through one year?
- What type of basis swaps (what pay, receive position) did the bank appear to take to produce the GAP effect needed?

**V. CONVERTING FIXED-RATE LOANS TO FLOATING-RATE LOANS.** Your bank made a 3-year fixed rate loan to Fresh Corporation at 8.50 percent. The ALCO wants only to accept floating-rate loans so that it can reduce its liability sensitivity. Using the following information, indicate what position the bank should take to convert this fixed-rate loan to a floating-rate loan in the best possible manner. The current prime rate is 8.25 percent and 3-month LIBOR is 5.50 percent.

3-Year Basic Interest Rate Swap:                      Pay 8.22% Receive 3-month LIBOR  
Pay 3-month LIBOR    Receive 8.17%

	Bid/Offer Premium		
3-Year Interest Rate Cap on Prime Rate	8.25% Cap	8.50% Cap	9.00% Cap
Premium	0.71/0.68	0.52/0.47	0.20/0.15
3-Year Interest Rate Cap on 3-Mth LIBOR	5.50% Cap	5.75% Cap	6.00% Cap
Premium	0.95/0.90	0.70/0.64	0.47/0.42

- Describe what position you would take with a basic interest rate swap to reduce the bank's risk. Assume that the bank takes this position. What will its risk/return profile be?
  - Suppose that 3-month LIBOR rises by 1 percent after one year and remains at this higher level the next two years. What will the effective loan yield equal?
  - Suppose that 3-month LIBOR falls by 0.75 percent after one year and remains at this lower level the next two years. What will the effective loan yield equal?
- Describe what position you would take with an interest rate cap. Which index (prime or LIBOR) would you use? Explain why. Which strike rate would you use? Explain why. Assume that the bank takes this position.
  - Suppose that LIBOR and the prime rate rise by 1 percent after one year and remain at these higher levels the next two years. What will the effective loan yield equal?
  - Suppose that LIBOR and the prime rate fall by 0.75 percent after one year and remain at these lower levels the next two years. What will the effective loan yield equal?

**Table 18 Interest Rate Sensitivity**  
**December 31, 2004**

(Dollars in millions)

	<b>0-3 Months</b>	<b>4-12 Months</b>	<b>1-5 Years</b>	<b>Over 5 Years</b>
Investment securities available for sale (*)	\$ 287.7	249.6	1,659.8	498.7
Loans, net of unearned income	13,800.4	1,965.9	3,337.3	376.9
Mortgage loans held for sale	120.2	—	—	—
Other	139.6	—	—	—
Interest sensitive assets	<u>14,347.8</u>	<u>2,215.5</u>	<u>4,997.1</u>	<u>875.0</u>
Deposits	7,826.8	2,698.3	4,640.7	578.8
Other borrowings	1,870.0	329.6	390.8	497.3
Interest sensitive liabilities	<u>9,196.8</u>	<u>3,022.9</u>	<u>5,031.5</u>	<u>1,076.1</u>
Interest rate swaps	(977.5)	300.0	330.0	347.5
Interest sensitivity gap	<u>\$4,173.5</u>	<u>(507.4)</u>	<u>296.6</u>	<u>147.0</u>
Cumulative interest sensitivity gap	<u>\$4,173.5</u>	<u>3,666.1</u>	<u>8,961.7</u>	<u>4,108.7</u>
Cumulative interest sensitivity gap as a percentage of total interest sensitive assets	<u>18.6%</u>	<u>16.3</u>	<u>17.7</u>	<u>18.3</u>
<b>December 31, 2003</b>				
	<b>0-3 Months</b>	<b>4-12 Months</b>	<b>1-5 Years</b>	<b>Over 5 Years</b>
Investment securities available for sale (*)	\$ 465.5	708.1	970.0	352.8
Loans, net of unearned income	9,460.3	2,320.3	4,066.5	617.8
Mortgage loans held for sale	133.3	—	—	—
Other	177.3	—	—	—
Interest sensitive assets	<u>10,236.4</u>	<u>3,028.4</u>	<u>5,036.5</u>	<u>970.6</u>
Deposits	4,509.8	3,144.3	4,850.1	597.9
Other borrowings	1,686.1	31.9	667.2	504.0
Interest sensitive liabilities	<u>6,195.9</u>	<u>3,176.2</u>	<u>5,523.3</u>	<u>1,101.9</u>
Interest rate swaps	(337.5)	45.0	570.0	272.5
Interest sensitivity gap	<u>\$3,153.0</u>	<u>(102.8)</u>	<u>83.2</u>	<u>141.2</u>
Cumulative interest sensitivity gap	<u>\$3,153.0</u>	<u>3,050.2</u>	<u>3,133.4</u>	<u>3,274.6</u>
Cumulative interest sensitivity gap as a percentage of total interest sensitive assets	<u>16.4%</u>	<u>15.8</u>	<u>16.3</u>	<u>17.0</u>

(\*) Excludes net unrealized losses of \$224 thousand and net unrealized gains of \$32.8 million at December 31, 2004 and 2003, respectively.

