The Use of Derivative Financial Instruments to Reduce Risk

LEARNING OBJECTIVES

This chapter builds on the preceding chapters by explaining that a firm’s borrowings give rise to a form of risk called interest-rate risk. This provides a platform for discussion of financial instruments that can be used to manage interest-rate risk. These instruments are called derivatives, notable examples being futures, options and interest-rate swaps. The workings and uses of these instruments are explained, along with a discussion of the need for firms to have a policy for managing risk and using derivatives.

When you have completed this chapter you will:

- have an appreciation of the general nature of interest-rate risk;
- recognise the nature and uses of derivative financial instruments;
- understand the workings of futures contracts and markets;
- be able to construct elementary risk hedges using interest-rate futures;
- understand some of the limitations of hedging with futures;
- know the main differences between futures and forward rate agreements;
- understand the nature and terminology of options contracts and markets;
- be able to price options at expiration;
- appreciate some of the uses of options by the financial manager;
- understand the general nature of products such as caps, floors and collars;
- know the general workings of interest-rate swaps;
be able to analyse interest flows for basic and intermediated swaps;
- appreciate some of the uses of swaps by financial managers;
- recognise the significance of derivatives in contemporary financial markets and the general circumstances appropriate for their use, as well as their risks.

In previous chapters, we have looked at the characteristics of typical interest-bearing financial instruments used to fund the firm’s activities, such as bills (Chapter 7), debentures and other bond-type instruments and term loans and leases (Chapter 18). A feature of using these instruments is that the borrower is exposed to interest-rate risk. Unexpected increases in interest rates may cause a borrower’s expense budget to blow-out. Or they may lead to a reduction in the value of a portfolio of interest-bearing securities. On the other hand, a decrease in interest rates may lead to a reduction in an investor’s interest income.

In this chapter, after a brief examination of the characteristics of interest-rate risk, we take a look at three types of derivative financial instruments that are used to manage interest-rate risk. These instruments are called derivatives because they are based on (derived from) particular physical or actual financial instruments. We start with a look at futures contracts, which have uses such as enabling a future interest rate to be set in advance. Subsequently, we take a look at options, which give the option-holder the right to do things such as buy or sell a financial instrument in the future at a specific price (thus setting the interest rate), but not the obligation to do so. We then introduce swaps, instruments that enable a borrower or lender to do such things as exchange a variable interest stream for a fixed stream. The chapter concludes with an overview of the way in which the financial manager should establish a program to manage interest-rate risk.

AN INTRODUCTION TO INTEREST-RATE RISK

Interest-rate risk is basically the threat posed by unexpected changes in interest rates. More formally, interest-rate risk can be defined as the uncertainty surrounding expected returns on a security, brought about by changes in interest rates. Let us look at some examples.

Suppose a firm has used a bill facility to borrow $500,000 for a year, planning to rollover the debt every 90 days (that is, to refinance a 90-day bill with another such bill). Let’s assume that the firm’s first such bill bears an interest rate of 8% per year and the firm expects this rate to be stable in successive quarters, although it could vary each quarter as rollover occurs. Thus, it will budget for annual interest costs of about $40,000 (8% of
$500,000). However, what if interest rates were to rise in the subsequent quarters? This would pose a threat to the firm’s budget.

The preceding example is indicative of the risk of using floating-rate or variable rate borrowing. Interest-rate risk affects fixed-rate debt, too. For example, if a firm contracts for a four-year, fixed-rate lease, and then interest rates drop unexpectedly, the firm will lose the opportunity to borrow at the lower rate (because it has entered into a fixed-rate borrowing arrangement). Not only does interest-rate risk affect borrowers but also it affects investors. For instance, a holder of treasury savings bonds will receive a fixed rate of coupon interest till maturity, so if rates rise on new issues, the investor will lose the opportunity to earn the higher rate. The market recognises this via a fall in the price of the bonds.¹

Historically, finance managers have had few avenues to deal with risk of the above kinds. But in the past few decades there has been an explosion in instruments called derivatives. Among other things, these derivatives are used for helping to manage interest-rate risk. Examples are financial futures, options and interest-rate swaps. They are called derivatives because they are based on (or derived from) actual (“physical”) financial instruments. For example, one type of financial future is based on 90-day bank-accepted bills; this futures contract enables the finance manager to agree, in advance, the future price (and thus interest rate) of a 90-day bill, therefore locking-in the rate and protecting against interest-rate changes.

Derivative instruments such as futures contracts are useful to investors as well as borrowers. They can also be used by speculators aiming to make profits by speculating on interest-rate movements. In this chapter we emphasise the use of derivatives as aids to managing interest-rate risk associated with the use of debt-financing instruments of the kinds discussed in previous chapters. However, we shall mention, in passing, other uses of derivatives. As well, it should be pointed out that instruments such as futures and options can be based on things other than financial instruments. For example, it is possible to enter futures contracts for some commodities,² thus enabling, say, a prospective buyer of wheat to lock-in a future price and so protect against price rises in the meantime.

The finance manager needs to be aware of opportunities to manage many kinds of risks, not only the firm’s interest-bearing borrowings or investments, but also any risks associated with foreign transactions³ as well as risks associated with price fluctuations in the key commodities in which the firm deals. The large firm may have a treasury division whose activities are likely to embrace the use of derivative instruments. The smaller firm, on the other hand, is likely to use a financial institution, such as its bank, to sell it products that help the firm to manage interest-rate risk (for example, the bank may enter a
forward rate agreement, or FRA, with the firm, enabling the firm to lock-in a future interest rate). In this chapter we will look at futures, options and swaps, with our main emphasis on the use of these derivative instruments to manage interest-rate risk. But we will also draw attention to some other derivatives (such as share options) and their uses.

FUTURES

Using futures contracts to hedge against interest-rate changes
In the previous section we introduced the risk confronted by a borrower using 90-day bank bills to raise about $500,000. How can this borrower hedge the risk of rising rates by means of futures contracts? Such a contract simply enables the setting, today, of a future price. Formally, a futures contract may be defined as a contract to buy or sell a stated commodity or financial claim at a specified price at some future, specified time.

EXAMPLE 21.1

1. A firm is currently paying 8% per year on a 90-day bank bill with a face value of $500,000. The debt was raised about a month ago, and the firm wishes to hedge against rising rates when the bill is rolled over in two months time. The finance manager knows that 90-day bank-accepted bills (BAB) are traded on the futures exchange in multiples of $500,000, so the manager can construct a hedge against rising rates.

2. The futures market is currently quoting an 8.2% rate on contracts to be settled two months hence. (We will explain later the pricing convention used to specify this rate.) The finance manager’s fear is that rates might rise even higher, so the manager takes a selling position (called a short position) in the futures market. This means that the manager commits the firm to an agreement to sell a $500,000, 90-day BAB in two months time, at a rate of 8.2% per year.

3. By agreeing to sell a $500,000 face value BAB at 8.2%, the finance manager is contracting to sell it for $490,091. Remember from equation (7-8) that the price of a bill is the present value \( P \) of its face value \( V \), given by:

\[
P = \frac{365V}{365 + RATE(n)}
\]

(21-1)
where \( V \) = the face value (maturity value) \\
\( P \) = the present value (or price) \\
\( RATE \) = the annual interest rate \\
\( n \) = the number of days till maturity

Substituting for \( V = $500,000 \), \( RATE = 8.2\% \) (.082), and \( n = 90 \) days:

\[
P = \frac{365($500,000)}{365 + .082(90)} = $490,091
\]

4. Now suppose that the two months have elapsed and rates on actual ("physical") 90-day BABs have risen to, say, 9\% per year. This means that buying a $500,000 BAB would then cost $489,145 [equal to \( \frac{365($500,000)}{365 + (.09)(90)} \)]. However, the finance manager has a contract to sell a $500,000 BAB for $490,091. So, the firm can walk away with a $946 profit, the difference between the price at which it can actually buy ($489,145) and the price at which it has a contract to sell ($490,091). (In practice, the firm will not have to buy and resell—the futures exchange will “close out” the contract and simply remit the profit to the recipient.)

5. When the firm now comes to roll-over its bill, it will have to do so at the going interest rate of 9\% in the physical market for bills, meaning (as calculated in 4) that it will realise proceeds of $489,145 on its bill borrowing. But, adding the futures contract's profit of $946, the firm receives a total of $490,091. As we have seen in 3 above, such a present value represents a net interest rate of 8.2\% per year.

Cash-flow time-lines summarising the above transactions are shown in Figure 21.1.5

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Hedging against interest-rate increases

Generalising from the above example, if you wish to hedge against future interest rate increases, you must take a selling position in the futures market. The resultant futures contract profit, if rates do rise, has the effect of keeping down the cost of borrowing. But what if rates had fallen unexpectedly? Then there would be a loss on the futures contract. This loss would offset the lower borrowing cost otherwise obtainable in the physical market for BABs, with the result that the borrower misses the opportunity to benefit from the lower rate. For example, suppose that in 4 above the rate two months hence had actually fallen to 7.5\%; this represents “physical” bill proceeds of $490,921, against which there will be a loss of $830 on the futures contract. This loss stems from the fact that the firm has agreed to sell for $490,091 a bill that now has a market value of $490,921, so there is a loss of $830. So raising funds via an
The actual bill at the ruling physical market rate of 7.5% would realise proceeds of $490,921, from which the loss of $830 on the futures contract must be deducted. Therefore, net proceeds of the bill rollover would be $490,091 which, as we have seen, represents a net interest rate of 8.2%. The cash-flow diagrams for this situation are depicted in Figure 21.2.

**Hedging against falling interest rates**

An investor or potential investor faces the converse problem to that of the borrower illustrated above; the investor will want to hedge against falling rates. This can be accomplished by taking a *buying position* in the futures market (called a **long position**). That is, the investor enters a contract agreeing to buy a BAB in the future, at a price specified today. For example, suppose that a firm expects to have about $500,000 to invest in bank bills in a month's time. The firm fears that rates may fall below the level of 8.2% currently quoted in the futures market for settlement a month hence, so it enters a futures contract, to be settled then, agreeing to buy a $500,000 BAB. Now, suppose that a month has elapsed and rates have fallen to 7.5% on bank bills. As computed above, the firm would have to outlay $490,921 to invest in (buy) a $500,000 90-day bill yielding 7.5%. But the firm has a contract enabling it to...
to buy for only $490,091, the price for the contracted futures rate of 8.2%. Accordingly, there is a futures contract profit of $830 which enables the firm to reduce its net outlay on an actual $500,000 bill from $490,921 to $490,091, so netting a yield of 8.2%,7 as planned via the hedging strategy. The cash-flow diagrams for this hedge are shown in Figure 21.3.

Using futures contracts for speculative purposes
The efficient functioning of the futures market depends on having a reasonable “depth” to the market. The volume of contracts is swelled by the presence of speculators, who buy and sell futures with a view to profit rather than hedging. For example, suppose a speculator believes that interest rates will rise above the level at which futures contracts are currently being traded. Drawing on the previous example of $500,000 BAB futures, we saw that, if rates rise, a profit is produced by means of taking a selling position. Specifically, a standard futures contract for $500,000 face value BABs at 8.2% would produce a profit of $946 if rates rose to 9%. Since it is customary for the futures exchange to settle the profit (or loss) with the market player, the speculator can walk away with nearly a $1,000 profit per standard contract, under the above
assumptions. What makes the market particularly attractive to such speculators is that they do not have to have any actual bills to enter the futures contract nor do they have to pay the face value. All they have to do is place the required deposit with the exchange and, if their strategy proves apt, take the eventual profit. For example, suppose the player had taken a short position on one standard contract and was required to pay a deposit of $500 two months prior to settlement, then emerged with the profit of $946; this would represent an annual rate of return of over 1,000% on a simple interest basis.8

We have seen that if rates were, instead, to fall in the previous paragraph’s example, the player would emerge with a loss. This would have to be paid to the futures exchange. The exchange protects itself against failure of players to settle their losses by requiring periodic, additional payments titled margin calls. For example, if rates began to slide downwards, so exposing the player to potential losses, the exchange could demand that the player pay these additional calls, reserving the right to close-out the contract and apply the proceeds against accrued losses if the calls are not paid when due.

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**FIGURE 21.3**

*CASH-FLOW DIAGRAMS FOR INVESTOR’S FUTURES HEDGE AGAINST FALLING RATES*

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*margin call* A payment made subsequent to the deposit on a contract, such as a call paid to the futures exchange under a futures contract.
The futures market

Futures contracts are traded primarily on the Sydney Futures Exchange (SFE), which commenced operations in 1960 with trading of wool futures. Subsequently, other contracts were added, including commodities such as cattle, some metals, and petroleum. The SFE acts as a clearing house, ensuring that each buying position is matched by an equal but opposite selling position.

A contract with the SFE is entered “now” with settlement at an agreed future date. On this date, as introduced above, the typical market participant will simply settle the profit or loss on the contract. This is the result of the fact that participants generally enter a contract in order to fix the future price, with no intention of delivering the commodity (as seller) or taking delivery (as buyer). It is worth making the point that market participants cannot set the price or interest rate that they would like. On the date they enter or leave the market, they will do so at the ruling market rate.

The market price of a specific contract varies from day to day as settlement approaches. A participant, however, does not have to hold the contract till maturity. For instance, if the firm in the example that began this chapter found that interest rates on bills started to fall (rather than to rise as feared) after it had entered the contract, it could reverse its position by buying a contract at the ruling market price, thus offsetting its original selling position. In this event, the firm would almost certainly emerge with a loss, but it might have figured this is better than remaining in the market till settlement, if rates were to continue their unexpected slide.

There are specific conventions for quoting the “price” of a futures contract. For interest rate futures such as the BAB contract, the figure is reported as an index, shown as 100 minus the yield (interest rate), to two decimal places. This figure is quoted in the daily financial press and on the screen-based networks conducted by firms which provide up-to-date financial information to computer terminals at the premises of their subscribers. For example, at the date on which the contract to sell a BAB contract was entered at a yield of 8.20%, the market quote would have been shown as 91.80 (100 minus 8.20%). This convention is also used to quote the price of other interest-rate futures. In addition to financial futures based on bank-accepted bills, there are standard contracts for 3-year and 10-year Australian government treasury bonds, based on $100,000 face value per contract. These may be used by hedgers wishing to manage interest-rate risk on medium- to longer-term instruments. For example, a holder of a portfolio of bonds could hedge against an interest-rate rise (which would lead to a decline in the value of the assets) by taking a selling position. As we have seen, this would produce a futures contract profit should rates rise, and this profit would tend to compensate for the decline in value of the bond portfolio.
Apart from BAB and bond futures, another popular financial futures contract is based on movements in the share-price index (SPI). This involves a standard contract equal to twenty-five dollars times the value of the ASX 200 Share Price Index. For example, if the index value on a particular day is 2120, each contract will be settled at $53,000 ($25 \times 2120). To give an illustration of the use of this contract, suppose an investor with a diversified portfolio currently worth about $1 million wants to protect against a fall in its value in a year’s time. If the current futures market quote is 2120 for settlement a year hence, the investor can take a selling position (agreeing to sell about 19 standard contracts, therefore, at a settlement price of $1,007,000, or 19 \times $53,000). Suppose that a year later, at settlement date, the actual market index has fallen by 30 points to 2090; the investor will then emerge with a profit of $750 (30 points \times $25) per contract, an overall profit of $14,250. This profit will help to compensate for the fall in the worth of the portfolio that is implicit in the decreased index value.

**Limitations of hedging with futures contracts**

There are a number of difficulties associated with hedging by use of futures contracts. Some of these difficulties can be illustrated by reference to BAB futures.

- **Futures are traded in standard amounts or quantities.** For example, each BAB futures contract is for a bill with a face value of $500,000. Thus, market participants wishing to hedge amounts other than multiples of $500,000 may be unable to develop an exact hedge.

- **The price (or rate) on the futures contract is for a specific commodity.** Trying to hedge a different commodity may not produce an exact hedge. For instance, BAB futures are naturally suited to hedging actual borrowings of, or investments in, bank bills. If a borrower has raised some other form of short-term debt, its interest rate may not move in line with rates on BAB’s, so it will be difficult to construct a perfect hedge.

- **Futures contracts are settled on specified dates.** Unless these dates coincide with the dates of physical market transactions that the hedger wishes to employ, there will be a “gap” in the hedging process.

**Forward rate agreements**

Limitations of futures contracts such as those outlined above have left the way open to financial institutions such as commercial banks and merchant banks to market instruments called forward rate agreements (FRAs). In fact, FRAs predate the development of futures markets. A **forward rate agreement** is a contract between two parties whereby there is an agreement on a future interest rate, starting at a specific future date. Because they are arranged
directly between two parties, rather than through an exchange, they are called **over-the-counter (OTC) transactions**.

Why would a firm want to enter into a FRA? It might, for example, be receiving a $2 million cash payment four months from now that it would be able to invest for 9 months in a security whose rates are not perfectly aligned with bank bills, and so by entering into a FRA with an appropriate interest-rate basis, it can lock-in its earning rate. Note that there is no exchange of principal; instead, the two parties exchange a profit or loss based on a notional amount of principal and on movements in market interest rates between the date the contract is written and the settlement date. This is analogous to profits or losses on futures contracts, the effect of which is to add to (or reduce) proceeds of a transaction in the physical market, thus hedging that transaction. Although FRAs are able to be developed to satisfy the specific needs of a firm, they have the disadvantage that they cannot be traded like futures contracts and, also like futures, they possess the property of hedging unfavourable outcomes but preventing the benefit of favourable outcomes.

### OPTIONS

**Options on futures contracts**

As we have seen, financial futures contracts and FRAs are ways of hedging against unfavourable movements in interest rates. However, we have also seen that, if interest rates move favourably (in the direction that the hedger would prefer), the futures or FRA contract prevents the hedger from obtaining this benefit. To put it another way, they *protect* hedgers from *downside* risk (unfavourable outcomes), but they *prevent* enjoyment of *upside* risk (favourable outcomes). Futures contracts are a two-(h)edged sword!

This inherent limitation of futures contracts has been reduced by the development of markets for options. For example, options can be purchased on some financial instrument futures. An option on a bond futures contract allows the option holder to proceed with the transaction if it suits, or not to proceed.

Why, then, would anyone prefer futures contracts to options on futures contracts? The answer is that options are not free. The purchaser of the option pays a price (called the *premium*) to another party, called the seller or writer of the option. This premium therefore reduces the gain that would otherwise emerge if there had been only a futures contract. If the option is not exercised, the premium represents a loss.

**The terminology of options**

As introduced above, an option, or option contract, gives its owner the right (but not the obligation) to buy or sell a commodity at a specified price over...
Some time period. There are two basic types of options. A *call option* gives the owner the right to buy an asset at a specified price over a given period of time, and a *put option* gives its owner the right to sell.

An option is merely a contract between two investors. The buyer of the option is, in a sense, betting against the writer (seller) of the option. If someone purchases a call option, that person will be hoping that the price will rise so that the market price will be higher than the price at which he or she has the option to buy. The profit is the excess of the market price over the price at which the asset can be bought under the option contract. If this happens, the writer of the option will lose a corresponding amount, because the writer has agreed to provide the other party with an asset whose market price is greater than the price at which the other party has the option to buy. So, in the absence of transaction costs, options markets would represent a zero sum game—if all profits and losses were added up, the net total would equal zero. As we shall see, options markets are quite complicated and risky. Some experts refer to them as legalised institutions for transferring wealth from the unsophisticated to the sophisticated.

In order to continue with our discussion, we need to define several terms that are unique to options.

- **The contract.** It should be stressed that, when an option is purchased, it is nothing more than a contract that allows the purchaser to buy (in the case of a call) or sell (in the case of a put) some underlying asset such as a company’s ordinary shares or a futures contract. That is, no asset has changed hands at the time the contract is entered into, but the price has been set for some future transaction that will occur only if the purchaser of the option wants it to. In this section we will refer to the process of selling a put or a call as *writing*. Consistent with our terminology for futures contract, selling options is referred to as taking a *short position*, while buying is referred to as a *long position*.

- **The exercise price or strike price.** This is the price at which the asset may be purchased from the writer in the case of a call, or sold to the writer in the case of a put.

- **Option premium.** This is merely the price of the option, the amount paid by the purchaser to the writer.

- **Expiration date.** This is the date on which the option contract expires. An American-type option is one that can be exercised any time until expiry, whereas a European-type option can be exercised only on expiration date.

- **Covered and naked options.** If the call writer owns the underlying asset, the writer is said to have written a *covered call*. Conversely, if he or she does not own the asset, it is a *naked call*. Thus, if a naked call is exercised, the
writer will have to acquire the asset in order to deliver it as required under the contract.

• **In-the-money, out-of-the-money, and at-the-money.** A call (put) is said to be **out-of-the-money** if the underlying asset is selling below (above) the exercise price. Alternatively, a call (put) is said to be **in-the-money** if the underlying asset is selling above (below) the exercise price. If the asset is selling at the exercise price, the option is said to be **at-the-money.** For example, if ABC Ltd ordinary shares are selling for $52, a call option with an exercise price of $50 would be in-the-money, while one with an exercise price of $60 would be out-of-the-money.

• **Intrinsic value** and **time (or speculative) value.** The term **intrinsic value** refers to the minimum value of the option—that is, the amount by which it is in-the-money. Thus, for a call the intrinsic value is the amount by which the asset price exceeds the exercise price. If the call is out-of-the-money, then the intrinsic value is zero. Why zero rather than negative? This is because a call option will not be exercised if its exercise price exceeds the asset price. For a put, the intrinsic value is again the minimum value that the put can sell for, namely the exercise price less the asset price. For example, if ABC shares were selling for $42 when the exercise price was $50, the intrinsic value of a put would be $8. If it was selling for anything less, investors would buy puts and sell the shares until all profits from this strategy were exhausted. This is an example of the process of **arbitrage**—buying and selling like assets for different prices for a riskless profit. If an option is selling for its intrinsic value, it is said to be at **parity.**

The **time value, or speculative value, of an option** is the amount by which the option premium exceeds the intrinsic value of the option. The time value represents the amount above the intrinsic value that an investor is willing to pay to participate in capital gains from investing in the option. (These capital gains will arise if the asset price rises in the future above its current level.) At expiration, the time value falls to zero and the option sells for its intrinsic value, because the chance for future capital gain is exhausted. The foregoing relationships are summarised as follows:

\[
\begin{align*}
\text{call intrinsic value} &= \text{asset price} - \text{exercise price} \\
\text{put intrinsic value} &= \text{exercise price} - \text{asset price} \\
\text{call time value} &= \text{call premium} - (\text{asset price} - \text{exercise price}) \\
\text{put time value} &= \text{put premium} - (\text{exercise price} - \text{asset price})
\end{align*}
\]

**Introduction to the pricing of options**

Perhaps the easiest way to follow the above terminology and gain an understanding of the pricing of options is to use an example. The following example uses share options for illustrative purposes.
EXAMPLE 21.2

Figure 21.4 represents a profit and loss graph for the purchase of a call, at a premium of $4, on an ABC Ltd share with an exercise price of $50. In this and all other profit and loss graphs, the vertical axis represents the profit or loss realised on the option’s expiration date, and the horizontal axis represents the share price on that date. Because we are viewing the option at expiration, we are ignoring the time value and, to keep things simple, we will also ignore any transaction costs such as brokerage.

For the option shown in Figure 21.4, the call will be worthless if the value of the share is less than the exercise or strike price. This is because it would make no sense for an individual to exercise the call option for $50 per share if the same shares could be bought on the stock exchange for less than $50. Although the option will be worthless at expiry date if the exercise price is greater than the share price, the most an investor can lose is the premium, in this case $4. Although this may be the entire investment in the option, it is likely to be only a fraction of the share’s value. Once the share price climbs above the exercise price, the call option takes on a positive value and increases on a linear, one-for-one basis. Moreover, there is no limit on how high the profits can climb.

FIGURE 21.4
PURCHASE A CALL ON ABC LTD SHARES WITH AN EXERCISE PRICE OF $50 FOR A PREMIUM OF $4

[Diagram showing profit and loss graph for a call option, with labels indicating maximum profits, maximum loss, break-even point, and exercise or striking price.]
Once the share price rises above $50 the call begins taking on value and, once it hits $54, the investor breaks even. The investor has then earned enough in the way of profits to cover the $4 premium paid initially for the option.

As noted earlier, the options market is a zero sum game in which one individual gains at the expense of another. Thus, to the call writer, the profit and loss graph is the mirror image of the call purchaser’s graph. Figure 21.5 shows the profits and losses at expiration associated with writing the call option. Once again we will look at the profits and losses at expiration, because at that date options have no time value. The maximum profit to the call writer is the premium, or how much the writer received when the option contract was originally undertaken, whereas the maximum loss is unlimited.

In Figure 21.6 we look at the profit and loss graph for the purchase of a put option on ABC shares, again with an exercise price of $50 but with a premium of $3. We see from the graph that the lower the price of the shares the more the put is worth. Here, the put takes on value only once the share price drops below the exercise price, which in this case is $50. Then, for every dollar fall in the price of ABC shares, the put increases in value by one dollar. Once the ABC price drops to $47 per share, the put purchaser breaks even by making $3 on the put, which exactly offsets what was paid initially for the put.

**FIGURE 21.5**
WRITE (SELL) A CALL OPTION ON ABC LTD SHARES WITH AN EXERCISE PRICE OF $50 FOR A PREMIUM OF $4
**FIGURE 21.6**
PURCHASE A PUT ON ABC LTD SHARES WITH AN EXERCISE PRICE OF $50 FOR A PREMIUM OF $3

Maximum profits = $47

Break-even point (exercise price – premium) = $47

Maximum loss = $3

Exercise or striking price = $50

**FIGURE 21.7**
WRITE (SELL) A PUT OPTION ON ABC LTD SHARES WITH AN EXERCISE PRICE OF $50 FOR A PREMIUM OF $3

Maximum profits = $3

Break-even point (exercise price – premium) = $47

Maximum loss = $47

Exercise or striking price = $50
Here, as with the purchase of a call option, the most an investor can lose is the premium which, although small in dollar terms, still represents 100% of the investment. The maximum gain associated with the purchase of a put is limited only by the fact that the lowest a share’s price can fall is to zero.

To a put writer, the profit and loss graph is the mirror image of the put purchaser’s graph. The writer’s graph on the above ABC put is shown in Figure 21.7. Here, the most a put writer can earn is the premium or amount for which the put was sold. The potential losses for the put writer are limited only by the fact that the share price cannot fall below zero.

The time value of an option
All four of our graphs have shown the price of the option at expiration. At expiration, the option’s value depends on the current price of the underlying asset and on the exercise price. When we re-examine these relationships at a time before expiration, we find that the options now take on some time value. In other words, investors are willing to pay more than the intrinsic value of an option because of the uncertainty of the future share price. That is, although the share price may fluctuate, the possible losses are limited, whereas the possible gains are almost unlimited. The more the volatility (as measured by the standard deviation of the share price), the greater the potential for upside gains in the future (that is, the excess of the price of the share over the exercise price), and so the greater the present value of the option, other things being equal.

Thus far, we have seen that the price of an option prior to maturity depends on three things: the current price of the underlying asset such as a company share, the exercise price of the option, and the variability in the underlying asset’s price. As with any other financial instrument, the price today is the present value of the expected, future payoff. This present value depends in turn on the discount rate and the time remaining till expiry. In sum, therefore, the present value of an option depends on a total of five factors:

- the current price of the underlying asset;
- the exercise price of the option;
- the variability of the underlying asset’s price
- the time to maturity;
- the discount rate.11

These factors have been brought together in a famous option-pricing model developed by Black and Scholes.12 Although detailed discussion is outside the scope of this book, it is intuitively easy to grasp that an option’s current value depends on these five factors.
Uses of options by the financial manager

As we examine options from the viewpoint of the financial manager, we will see that they have some attractive features that help explain their popularity. There are three main reasons for their popularity: leverage, financial insurance and expansion of investment possibilities.

Leverage

Call options allow the financial manager the chance for unlimited capital gains with a very small investment. Because a call is only an option to buy, the most a financial manager can lose is the premium, which is usually a very small percentage of the value of the underlying asset. However, the potential for capital gains is potentially unlimited. When a financial manager owns a call, he or she controls or benefits directly from any price increases in the underlying asset. The idea of magnifying the potential return is an example of leverage. The idea is similar to the concept of leverage in physics, where a small force can lift a heavy load. Here, a small investment is doing the work of a much larger investment. Unfortunately, leverage is a double-edged sword: small price increases can produce a large percentage profit, but small price decreases can produce a large percentage loss. With an option, the maximum loss is limited to the amount invested. To illustrate this idea of leverage, if ABC shares are currently trading at $50, a $4 price change represents only about an 8% change in the share price, but 100% of the amount invested (the premium of $4).

Financial insurance

For the financial manager this is the most attractive feature of options. A put can be regarded as an insurance policy, with the premium paid for the put being the cost of the policy. When a put is purchased with an exercise price equal to the current asset price, it insures the holder against any decline in the asset price over the life of the put. This idea underlies the discussion of options on futures contracts with which we began this part of the chapter. It will be recalled that, in the example given of a firm wishing to protect against rising interest rates, the finance manager could buy a put option (option to sell) on a BAB futures contract, as an alternative to the futures contract itself. Doing so would allow the manager to benefit from upside risk (if rates moved downwards, the manager would not exercise the option), but protect against downside risk (if rates moved upwards, the manager would exercise the option). Under this arrangement, the maximum potential loss is the premium.

Expansion of investment possibilities

The use of puts, calls and combinations of them can enable an investor to expand the range of effective investment media held without changes in the physical assets in a portfolio. For instance, a portfolio manager with a
preponderance of property investments can benefit from movements in the share market by use of share options.

To sum up, understanding the popularity of puts and calls involves understanding (1) the concept of leverage (in the case of calls unlimited potential gains, and in the case of puts very large potential gains with limited and relatively small maximum potential losses) and (2) the concept of financial insurance. The worst that can happen to a holder of an option is to lose the amount invested.

**Options markets**

In Australia, options on shares are traded on the Australian Options Market, while options on futures contracts are traded on the Sydney Futures Exchange. In addition, an option on any asset can conceivably be arranged between two parties, on an over-the-counter basis. For example, some real estate contracts are protected by a “cooling-off” period. During the time prior to expiry of the cooling-off period, the purchaser has the right to withdraw from the contract. This right is obtained by paying the deposit under the contract. But, unlike many other options, this deposit will be refunded if the contract is not proceeded with.

**Over-the-counter products with options characteristics**

Financial institutions such as commercial banks and merchant banks have developed a range of options-like products that they market to customers. The product range includes:

- **Caps.** Interest-rate caps are marketed on the basis that the borrower will not have to pay more than some specified interest rate, even if rates move above that level. However, if the rate falls, the borrower benefits. In other words, the rate floats but does not exceed the cap. As an illustration, the finance manager in the example that began this chapter might arrange a loan of $500,000 whose rate is aligned with the 90-day bank-bill rate, at 8.2% for the first 90 days and with a cap of 9%. Thus, if bank-bill rates rise, the loan will not go over 9%, but if rates fall, the firm can benefit.

- **Floors.** An interest-rate floor is designed so that an investor will receive no less than the floor rate. If rates are higher, the investor will benefit from the higher rate, but is guaranteed not to earn less than the floor rate.

- **Collars.** An interest-rate collar is, essentially, a combination of a floor and a cap. The rate may float between some upper limit (the cap) and some lower limit (the floor). For example, this might suit a borrower who wants to be protected against very high rates but does not mind if the rate cannot fall below the specified floor.
You might ask, “Why does not everyone hedge their borrowing or investing with such products?” One reason is that the customer pays some kind of fee for the arrangement of this type of financial insurance. Also, firms with appropriate expertise and with in-house treasury divisions will design their own, less costly, risk-management strategies. Firms without such expertise may feel it is better to pay a price for the insurance than to run the risk of being unhedged.

Interest rate caps and similar products are likely to be arranged independently of the underlying principal—they feature exchange of only the interest amount. So, if a firm has a loan of, say, $10 million, this would be the notional principal amount on which a cap would be based. For example, suppose the cap was 15.8% p.a. and it was on the basis of quarterly intervals. If the current quarter’s interest rate rose to 16.2% p.a., the cap seller (for example the firm’s bank) would pay the excess to the cap buyer (the firm). In this case, the excess would be about 0.1%, a quarter of 0.4% (the excess of the annual rate over the cap). On a notional principal of $10 million, this would thus represent $10,000 paid to the firm for that quarter, the effect of which is clearly to limit the borrowing cost to its 15.8% annual ceiling. However, if prevailing rates were to be below the cap of 15.8%, there would be no payment from the cap writer to the firm. Forward rate agreements (FRAs), too, are written on the basis of a notional amount of principal, as are interest-rate swaps, to which we now turn.

Swaps are of relatively recent origin. It is said that they owe their beginnings to a Citibank executive taking a shower in 1981, pondering the predicament of a client, power utility Detroit Edison. “In a flash of genius … the banker … decided that each party [the bank and the customer] should raise funds it didn’t want, and then simply cover the other’s interest-payment obligations.”

SWAPS

The basic mechanism of interest-rate swaps

What was the flash of genius that sparked the development of interest-rate swaps? Basically, the executive realised that the bank had a comparative advantage over its client in raising funds. The bank could raise fixed-rate funds at 15%, whereas the client would have to pay 17%. In the floating-rate market, the bank could borrow at, say, the current bank bill rate (BBR), whereas the client would have to pay this plus 1%. So, the bank raised fixed funds at 15% and the client raised comparable floating funds at BBR plus 1%. Where is the genius in this? Let us examine the following summary of the transactions:

Bank: Pays 15% on fixed funds (in the market). Charges client 16.5% (via the swap agreement).

Client: Pays BBR + 1% on floating-rate funds (in the market). Charges bank BBR + 1% (via the swap agreement).

Outcome for bank: Receives 1.5% profit on fixed funds, loses 1% on what it would otherwise pay on floating-rate funds, thus yielding a net profit of 0.5%.
**Outcome for client:** Breaks even on floating funds, pays 16.5% to bank on fixed funds, a saving of 0.5% on what it would otherwise pay direct to the market (17%).

The net comparative advantage in this transaction is clearly 1%, split equally between the two parties so that each finishes 0.5% better off. This example is indicative of what has been termed the *arbitrage origins of swaps*—constructing a swap so that each party is better off, but without any increased risk. From the bank’s perspective, the assumption would be that entering a swap contract with the client would involve no more credit risk (risk of default) than lending money to the client. However, this does not mean that swaps are necessarily free of risk, as we shall see later.

It is customary to portray swaps by means of a diagram depicting each party, with directional arrows representing interest streams into or out of each firm. The swap diagram for the above transaction is shown in Figure 21.8, in which arrows represent interest streams.

**Settlement of swap interest streams**

Swaps of the above kind feature the exchange of interest-rate streams only—thus the name *interest-rate swap*. If the above swap was based on a notional principal of $10 million, the saving of 0.5% means each party would save $50,000 interest per year. However, there is no exchange of principal—all the parties exchange is the interest payments. In fact, only one net interest payment is made, depending on the current relationship between fixed and floating rates. To show a simplified account of how this exchange of interest occurs, let’s suppose the above swap is based on quarterly settlements for a time of five years (the term of the fixed-rate loan), tied to the rollover periods for 90-day bank bills, and with a notional principal of $10 million. If the BBR in the first quarter was, say, 14%, the bank would be obliged to pay 15% (BBR + 1%) to the firm. In turn, the firm would be obliged to pay the fixed rate of 16.5% to the bank, so the net payment by the firm is at a rate of 1.5%.

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**FIGURE 21.8**

**INTEREST FLOWS FOR BASIC INTEREST-RATE SWAP**

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**interest rate swap** Derivative instrument in which one party agrees to pay or receive a variable-rate interest stream and the other party agrees to a fixed-rate stream.
per year, or 0.375% for the quarter. On a notional principal of $10 million, this would be $37,500 paid to the bank. Next quarter, suppose the BBR is up half a percent; now, the net payment by the firm will decrease to 1% per year, or 0.25% for the quarter ($25,000). If the BBR increased yet another half a percent per year in the following quarter, the net payment by the firm would be 0.125% for the quarter, or $12,500. Going on from this time, assume that floating rates kept rising and that at some time in the future BBR plus 1% totalled 17%. In that quarter, the bank would have to pay net 0.5% per year to the firm.

**Intermediated swap**

The swap portrayed in Figure 21.8 is commonly known as a *plain vanilla swap*. This involves the exchange of a fixed-interest stream for a floating stream. However, it is not always possible for a firm desiring a swap to find another party with offsetting requirements (that is, one wants to pay a fixed rate on some notional amount of principal, the other wants to pay a floating rate on the same notional amount). Also, there is credit risk when two firms contract directly with each other. Swaps are generally for relatively long terms, so there is some uncertainty that the other party (the *counterparty*) will meet the future interest settlement amounts when due. For both of these reasons, financial institutions such as commercial banks and merchant banks act as swap intermediaries. Figure 21.9 shows the interest flows for an *intermediated swap* between firms A and B, with a bank acting as swap intermediary. In this example, we have supposed that company B can raise 4-year fixed debt at 16.1% or floating rate at 0.4% above the bank-bill rate (BBR), while company A can raise fixed debt at 15% or floating rate at 0.1% above the BBR. If A wants floating-rate borrowing and B wants fixed-rate financing, the comparative advantage can be split between them as well as the financial intermediary that arranges the swap and also absorbs the credit risk. If the financial intermediary charges 0.2% as an arrangement fee, both A and B are 0.2% better off via the swap. As summarised at the foot of Figure 21.9, A achieves floating-rate borrowing at BBR minus 0.1%, compared to BBR plus 0.1% without the swap, while B achieves fixed-rate borrowing at 15.9%, compared to 16.1% without the swap.

The advantages to firms A and B are: (1) they have not had to find the counterparty (in fact, the bank becomes the firms’ counterparty by interposing itself between A and B); (2) with the bank as counterparty, the two firms will not be worried about credit risk to the same extent as if they had dealt directly with each other.
**The swaps market**

The swaps market is primarily an over-the-counter market. The players in this market are mainly large firms and financial institutions. The financial institutions act not only as swap intermediaries, but they also arrange swaps on their own account for purposes such as hedging their balance sheets. In addition, *swap brokers* search for information on prospective clients’ needs so that they can bring them together in return for a fee.

The interest rates on which swaps are based are reported in the financial press and by screen-based services. These rates are closely aligned to rates in the physical market. The floating rate is linked to the rate on bank bills; it is known as the bank bill swap rate (BBSW). The fixed rate is linked to rates on semi-government securities.

In order to “unwind” an existing swap, there are several possibilities. One way is to seek another party to take over the remaining obligations under the swap. Another way is to use the swaps secondary market to trade the swap position.

**Uses of swaps**

As we have noted, the origin of swaps lies in the splitting of comparative advantage. This provides a profit-motive for encouraging the swap parties to enter the swap contract. However, there must be a fundamental need for fixed- or floating-rate debt on the part of the firms entering the swap. For example, company A in Figure 21.9 may believe that interest rates have peaked and are about to fall. Accordingly, it may think it is best to have floating-rate debt to take

![Diagram of intermediated interest-rate swap](image-url)
advantage of falling rates. With a swap, it can do this “artificially”, continuing to service its fixed-rate obligations in the physical market, but using a swap to provide the mechanism for floating-rate borrowings. What about company B? Clearly, its needs must be different. It may desire fixed-rate debt in order to lock-in its interest costs—that is, to reduce funding-cost uncertainty. Or, it might be hedging an asset or portfolio that has a fixed-rate earning stream, and thus it may want fixed-rate debt to avoid mismatches that could occur should the cost of floating funds rise relative to the fixed rate earned on assets.

In the case of company B, it is clear that the swap user has a hedging motive. However, company A is taking a speculative position, using the swap in the expectation that it will reduce future funding costs should interest rates fall. However, if rates rise, hindsight will prove the swap was inappropriate, leaving the firm to carry the burden of paying floating rates via the swap or to seek to unwind the swap in ways mentioned above. The problem is that, in circumstances of rising rates, the firm would most likely find itself exposed to a loss on the swap.¹⁶

Traders and speculators can use swaps to seek profit opportunities, substituting swaps for actions that would otherwise be carried out in the physical markets. For example, if a bond trader expects long-term rates to fall, it might build up a portfolio of long-term bonds whose price will rise in the event of a rate decrease (remember from Chapter 4 that security prices rise in response to rate falls). Alternatively, the trader could use a swap to pay floating and receive fixed, thus creating a fixed-interest stream allied to that of bond coupons (in other words, creating effectively a long-term financial security). If rates were to fall subsequently, there would be a profit on selling the swap in the secondary market.

We can now start to see that there are many ways of using swaps. Moreover, the use of swaps is not confined to exchanges of interest-rate streams. Many swaps involve currency exchanges. For example, an importer might have debts in an overseas country and so want to hedge against a rise in the value of the overseas currency (which would make the cost greater in Australian dollars, since more dollars would be needed to buy each unit of foreign currency in order to discharge the debt). Accordingly, the importer could enter a swap to exchange the overseas liability into Australian dollars, thus protecting against the risk of the above exchange-rate movement. To give another illustration of the use of swaps, M. K. Lewis¹⁷ notes that Australian borrowers face a thin local market for corporate bonds and, since all but a few large firms lack sufficient credit standing to borrow in international markets, they can create the effect of Australian-dollar, fixed-rate debt by means of a currency swap. To do this, a foreign bank raises fixed-rate Australian-dollar debt in the overseas market, swapping this for floating-rate US-dollar debt.
raised through the intervention of the Australian firm’s bank. This is classed as a *cross-currency interest-rate swap*, combining as it does the exchange of currencies and fixed for floating rates.

The latter example is illustrative of the development of *synthetic securities*. These combine two or more derivatives (in this case, an interest rate swap with a cross-currency swap), or combine derivatives with physical instruments. Owing to the large numbers of combinations of financial instruments that can synthesise others, the boundaries of financial instruments are being continually stretched.

### MANAGING USE OF DERIVATIVES

As summarised in Table 21.1, Campbell suggests that the finance manager should base the choice of derivative products on the following factors: *interest rate outlook*, the *current debt position* (fixed or floating), and the *desired rate profile* (fixed or floating). Depending on these factors, the table goes on to show the *hedging action* that should be taken, along with the *product to use*, followed by an indication of the nature of the *cash-flow risk exposure* that results from the action. For example, if the firm thinks (or fears) interest rates are set to rise and it currently has floating-rate debt, it will seek to fix rates before there is a rise. This can be accomplished by a swap or a FRA, both of which result in known cash-flow exposure (because, via the swap or FRA, the effect is to pay fixed rates).

Today’s widespread use of derivatives suggests that financial managers should not only understand how they work but also all implications of using

<table>
<thead>
<tr>
<th>INTEREST RATE OUTLOOK</th>
<th>CURRENT POSITION</th>
<th>DESIRED PROFILE</th>
<th>ACTION</th>
<th>PRODUCT TO USE</th>
<th>CASH-FLOW EXPOSURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rising</td>
<td>Floating</td>
<td>Fixed</td>
<td>Fix debt</td>
<td>Interest-rate swap/FRA</td>
<td>Known</td>
</tr>
<tr>
<td></td>
<td>Fixed</td>
<td>Fixed</td>
<td>Lengthen debt</td>
<td>Interest-rate swap/FRA</td>
<td>Known</td>
</tr>
<tr>
<td>Falling</td>
<td>Floating</td>
<td>Floating</td>
<td>Do nothing</td>
<td>None or cap against “disaster”</td>
<td>Known Limited to cap level</td>
</tr>
<tr>
<td></td>
<td>Fixed</td>
<td>Floating</td>
<td>Prepay fixed</td>
<td>Interest-rate swap/FRA or cap against “disaster”</td>
<td>Known Limited to cap level</td>
</tr>
<tr>
<td>Uncertain</td>
<td>Floating</td>
<td>Flexible</td>
<td>Combination</td>
<td>Collar</td>
<td>Limited within range</td>
</tr>
<tr>
<td></td>
<td>Fixed</td>
<td>Flexible</td>
<td>Combination</td>
<td>Collar</td>
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</tr>
</tbody>
</table>

**TABLE 21.1**

**WHAT DERIVATIVE PRODUCTS TO USE AND WHEN TO USE THEM**
them. As we have shown, although use of derivatives is in many cases designed
to reduce risk, it is ironic that their use may bring about additional risks. Risks
associated with derivatives include the following:

- **Credit risk.** This is the risk that the counterparty will default on its
  obligations under the contract. It is more prominent when future rates
  change against one party during the course of the contract. From a
  particular firm’s view, it can be minimised by arranging a contract with a
  financial institution of good standing or via an exchange such as the SFE,
  where this is appropriate.

- **Market risk.** This is the risk that value of a derivative will fall in response to
  changes in market rates. We previously gave an example for company A in
  Figure 21.9 of swapping into a floating rate in expectation of falling interest
  rates, but then having to confront a rate rise. In principle, risks arising from
  some derivatives can be further hedged, but the matter of timing is critical.
  Company A would have missed the boat if it had not taken action in time.
  Furthermore, as we have also seen in our discussion of futures, hedging may
  reduce downside risk but it can lead to elimination of the potential to
  benefit from upside risk.

- **Documentation risk.** This stems from the fact that derivatives trading is
  often arranged over the telephone, leaving the risk that follow-up
  documentation may be incorrect.

- **System and model risk.** Many processes for valuing and trading derivatives
  are based on mathematical models. These may incorporate errors or be
  based on historical data (for example, to estimate the variability of a firm’s
  shares when pricing its options), and these data may no longer be relevant.

- **Legal risk.** This kind of risk is prominent in international transactions, such
  as different countries’ bankruptcy rules if a counterparty defaults.

- **Accounting/tax risks.** Tax and accounting treatment of derivatives varies
  greatly. Growth in the derivatives markets has outstripped the development
  of accounting and tax principles. This has created uncertainty about
  recognising profits and losses, as well as valuing derivatives.

All in all, the use of derivative instruments to manage interest-rate risk
depends on the attitude of the firm’s financial manager. If the firm is risk
averse, it is more likely that hedging will be employed. The attitude of the firm
is also dependent on the extent of its exposure. If it is a heavy user of debt, it is
potentially more exposed to interest rate fluctuations than if it is a modest user
of debt. Furthermore, the economic outlook is important, for a firm
experiencing or fearing recession will possibly suffer a reduction in cash flows and profits from falling sales, so it may want to avoid the compounding effect of adverse interest-rate movements.

**SUMMARY**

A *futures contract* is a contract to buy or sell a stated commodity (such as wool) or a financial claim (such as bank-accepted bills) at a specified price and future time. This contract requires the user to buy or sell the asset at future settlement, unless the contract is closed-out in the meantime. Most futures contracts are entered so as to fix a future price or interest rate, and so delivery at settlement does not occur—the contract holder emerges with a profit or a loss that is settled with the futures exchange. Futures contracts can be used to hedge against downside risk (such as interest-rate increases confronted by a borrower), but they also lock-in the asset price or rate so there is loss of potential, beneficial price or rate movements (upside risk). Futures contracts are standardised with respect to the quantity of the underlying, “physical” asset, as well as settlement dates. Contracts in Australia are mainly settled via the Sydney Futures Exchange, which protects itself from potential losses by means of daily margin calls on open contracts. A *forward rate agreement (FRA)* is like a futures contract that is tailored to the specific needs of the party desiring the contract. That is, it need not be based on standardised quantities, prices or dates, although its specificity means that it cannot be traded on an exchange.

A *call option* gives its holder the right to buy an item (such as shares or interest-rate futures) at a specified price over a given period. In contrast, a *put option* gives the holder the right to sell. However, the option holder does not have the obligation to complete the transaction. The holder will exercise the option if it is of benefit to do so (for example, a call holder will exercise the option when the price of the asset is greater than the exercise price). In this way, the holder can avoid most downside risk but still benefit from upside risk. The price paid by the holder to the writer of the option is called the premium. Options can provide the firm with leverage, financial insurance and expansion of opportunities. Option-like products marketed by financial institutions include caps, floors and collars.

*Interest-rate swaps* enable one party to exchange a fixed-interest stream for a floating stream. They may be arranged directly between two parties (a “plain vanilla swap”), or via an intermediary such as a financial institution (*intermediated swap*). The fundamental motive for an interest rate swap is to share the comparative advantage that one firm has over another in different segments of the debt market. This can lead to rate differentials that can be split between the parties involved so that they all benefit in the form of lower
funding costs. Swaps can be used to manage interest-rate risk, for example by hedging a fixed-rate asset with a fixed-rate debt position created via the swap. They can also be used to create profit opportunities by simulating a position in the physical market. However, using swaps creates a potential loss exposure (market risk) should interest rates move against the position held by a swap party. They may also carry other risks, notably credit risk.

The financial manager should base the use of derivatives for hedging purposes on the firm’s attitude to risk as well as the extent of its exposure. Use of derivatives contracts is increasing markedly, and the products are becoming more and more complex, outstripping the ability of accounting and taxation authorities to keep up with them. This makes it all the more important for the financial manager to understand how derivatives work and the costs and benefits of their use.

**STUDY QUESTIONS**

21-1 Outline the nature of interest-rate risk and give some examples. In your answer, distinguish between downside risk and upside risk. Which of these two dimensions of risk does the hedger try to remove?

21-2 What is the difference between a commodity future and a financial future. Give an example of each.

21-3 Describe the essential aim of a hedge using interest-rate futures contracts. In your answer, distinguish between the aims of a long position and a short position.

21-4 Why is it said that futures are a “two-edged sword?”

21-5 Compare the advantages and disadvantages of futures and forward rate agreements.

21-6 Outline a situation in which a financial manager might use interest-rate (financial) futures. Describe what would happen if interest rates went up during the period following the transaction. What would happen if interest rates went down following the transaction?

21-7 What are the main differences between using futures and options on futures for hedging?

21-8 Assume yesterday’s quote for BAB futures to be settled two months hence was 91.50. What does this mean? If today’s quote is 91.60, what does this imply about interest-rate trends? How do you think the price of a long futures contract would be affected by this rate movement?

21-9 Distinguish between a call option and a put option. Comment on the differences between the strategies of buying a call and writing a put.

21-10 What are the two factors that determine the price of an option at expiration? Explain why three other factors come into play when determining the price of the option prior to expiration.
21-11 What is the basic nature of an interest-rate swap? What is meant by “notional principal”?

21-12 Compare a “plain vanilla swap” with an intermediated swap. What are the advantages to the swap parties in each case?

21-13 Outline some of the ways in which swaps can be used for hedging.

SELF-TEST PROBLEMS

ST-1 In a few weeks your firm is going to borrow around $500,000 for three months in the bank-bill market. Current rates on bills are 8% and the futures market is quoting a rate of 8.2% for settlement a few weeks away. However, you fear rates may actually rise further, so you decide to recommend a futures hedge to the company treasurer. Outline the cash flows for this hedge, assuming rates have risen to 8.7% per year when the contract is settled. How much did you save your firm?

ST-2 In relation to Figure 21.4, state the break-even point, maximum loss and maximum profits if the strike price was $60 and the premium was $6. What would be the outcome at expiry date if the share is then priced at $69. What if the price then was $48?

ST-3 For the option in ST-2, state the maximum profits, break-even point and maximum loss from the perspective of the option writer.

ST-4 Draw an interest-rate-swap diagram for companies X and Y. Company X can borrow fixed-rate funds at 16% and floating-rate funds at BBR. Company Y can borrow fixed funds at 17.2% and floating funds at BBR plus 0.4%. At the foot of your diagram, identify the advantage to each party from the swap. Company X wants floating debt, Y wants fixed borrowings.

STUDY PROBLEMS

21-1 Your parents have invested in a bill-type deposit with a three-month term and with maturity value of half a million dollars. The current rate paid by the deposit is 9.5% per year. When the deposit matures in two months, your folks fear rates may have fallen by 1% per annum. They plan to reinvest during the three months following the current investment, after which they will cash in the proceeds and build a dream house in Queensland. On hearing of their plight, you decide to construct a hedge in the futures market. Prepare cash-flow diagrams for the hedge, assuming rates do fall as feared by your parents.

21-2 In problem 21-1, if rates were to rise to 11% in two months’ time, how much money would you lose for your parents.

21-3 You are a financial manager with approximately two million dollars of floating rate debt, rolled over every three months. The interest rate on this borrowing is closely aligned with rates on bank bills. If rates rise, you know your budget for interest expense will be affected adversely when the debt matures in a month’s time.
The current “price” quote in the futures market for settlement a month hence is 90.00.

(a) Outline, step by step, the effect of a futures hedging strategy, assuming the rate on “physical” bank bills at settlement was 10.8%. (Hint: If you are hedging a debt of $2 million, you will need four standard BAB futures contracts).

(b) Draw cash-flow diagrams summarising the transactions in the physical and futures markets, as well as a consolidated diagram showing the overall cash flows.

(c) Explain, with appropriate diagrams, what would have happened if the rate at settlement was 9% per year.

21-4 Assume a federal government bond with a face value of $5 million, paying coupons annually at a rate of 10 percent, has three-and-a-half years till maturity, and has a current price of par ($5 million). You think you might have to sell the bond in a half-year’s time.

(a) What would be the price of the bond in six months’ time if rates were to rise to 11%?

(b) Explain in general terms how you might construct a hedge to protect your bonds should rates move as outlined in (a).

21-5 In problem 21-1, assume you had constructed a hedge assuming a suitable option on futures is available. What sort of option would you have bought?

(a) Explain the effect in the cash-flow diagrams if the option had cost a premium of $500.

(b) Explain the effect in problem 21-2.

21-6 Draw a profit or loss graph, similar to Figure 21.4, for the purchase of a call with an exercise price of $65 for which a $9 premium is paid. Identify the break-even point, maximum profit and maximum loss. Now draw the profit or loss graph assuming an exercise price of $70 and a $6 premium.

21-7 Repeat problem 21-6, but this time draw the profit or loss graph (similar to Figure 21.5) for the call writer.

21-8 Draw a profit or loss graph (similar to Figure 21.6) for the purchase of a put contract with an exercise price of $45 for which a premium of $5 is paid. Identify the break-even point, maximum profits and maximum losses.

21-9 Repeat problem 21.8, but this time draw the profit or loss graph (similar to Figure 21.7) for the seller of the put contract.

21-10 Assume your firm has entered into an interest-rate cap agreement with your bank, as you fear rates are about to rise and to continue to do so as the economy recovers. The cap is set for three years at 12% and rates are currently 10.5% per year on floating-rate debt. The agreement is based on notional principal of $15 million and on quarterly settlements of interest. The cap premium was 1% of notional principal. At the end of the first quarter, floating-rate debt had gone up to 11%. Two years later, it was 12%. Two-and-a-half years later, it was 12.5%. Do you think the cap had been worthwhile? Use appropriate data to support your answer.
21-11 Company AAA has a top credit rating and can borrow fixed-rate funds at 12% or floating at the current rate on bank bills. Company BBB has a lesser credit rating and can borrow fixed-rate funds at 13% or floating at BBR plus 0.4%.

(a) Draw an interest-rate-swap diagram, indicating the gain to each party if the comparative advantage is evenly split. AAA wants fixed funds, while BBB wants floating.

(b) Why might AAA want fixed funds?

21-12 Repeat problem 21-11, this time assuming that a bank has brought together the parties for a charge of 0.2% on each “leg” of the swap.

21-13 For problem 21-11, show the net cash payment (assuming quarterly settlements) for the first two quarters after the swap was entered, assuming the bank bill rate dropped 0.2% per year each quarter, if the swap is based on notional principal of $50 million. To whose advantage is the rate change? What do you think would happen if AAA wanted to sell its swap position on the secondary market, six months after it had entered the swap.

SELF-TEST SOLUTIONS

SS-1 The firm will want to take a selling position (short hedge) in the futures market. It will contract to sell a standard BAB contract at 8.2% ($490,091 as shown in Example 21.1). If rates move to 8.7% at settlement, the firm would be able to buy a standard contract for $489,499 (equal to $500,000$\times(365 + (0.087)(90))/(365 + 0.087(90)))$. This implies a profit of $592, the excess of the amount for which it has a contract to sell over the price at which it could buy and thus the amount saved compared with not hedging. The cash-flow diagrams are shown in Figure 21.10.

SS-2 Break-even point: $66
Maximum loss: $6
Maximum profit: unlimited

If the price at expiry was $69, you would exercise the option and the profit would be $3. If the price was $48, you would not exercise the option and the loss would be $6 (the premium amount).

SS-3 Break-even point: $66
Maximum loss: unlimited
Maximum profit: $6

SS-4 See Figure 21.11.

*Company X*: Gains 0.8% on fixed; loses 0.4% on what it would otherwise pay on floating; net gain 0.4%

*Company Y*: Breaks even on floating; gains 0.4% on what it would otherwise pay on fixed; net gain 0.4%.

Second quarter: Floating market rate 15.8%. Nil payment (market rate equals cap ceiling).
Third quarter: Floating market rate 16.2%, so bank pays client 0.4% per annum (0.1% per quarter). For a notional principal of $10 million, this 0.1% represents $10,000.
If rates had fallen successively from a start of 15%, no payments would be made.

N O T E S

1. In Chapter 4, we saw that the price of a fixed-rate instrument such as a bond moves inversely to the interest rate.
2. Commodities for which futures contracts are traded in Australia include wool, cattle, some metals, and petroleum. In addition, futures are traded on 90-day bank-accepted bills, Australian treasury bonds of several maturities, and the Share Price Index.

3. For instance, firms engaged in foreign activities may be exposed to exchange-rate risk, which we discuss in Chapter 20.

4. The term short arises from the fact that the seller is agreeing to sell something that he or she does not possess and is thus “short” of it. It is contrasted with a long position, whereby there is an agreement to buy something.

5. The example summarised in Figure 21.1 is a simplified depiction. In reality, the firm will have to pay a deposit to enter the futures contract. If it makes a profit, it will recoup this profit at settlement. For example, assume the deposit is $800. In this case we will have to modify Figure 21.1 by inserting a cash outflow of $800 at the beginning of the futures market time-line, and a $800 cash inflow two months later on the same time-line.

6. The price is given by: \( P = \frac{(365)(500,000)}{365 + (0.075)(90)} = 490,921 \).

7. The obsevant reader might say, in relation to this and the previous example of a borrower’s hedge: “Why go ahead with a transaction in the physical market and couple this with the bill for $490,091?” There are several answers to this. First, the borrower firm might want to stay with its banker who has arranged the bill facility in the physical market. Second, in some futures markets, physical “delivery” of the underlying commodity is not permitted. All participants can do is take their profit or loss.

8. The player outlays $500 “now”, then gets this back, plus a profit of $946, two months later. The equation relating the future value to the present value is thus $1446 = 500(1+i). Solving for i gives \( i = 1446/500 - 1 = 1.892 = 189.2\% \). This is a rate for two months, representing simple interest of 1,135% per year (6 x 189.2). Can you work out the compound annual rate?

9. This index represents the average price movements in the leading 200 shares on the Australian market.


11. The appropriate discount rate is the risk-free rate of interest.

12. For a brief discussion of the use of the Black-Scholes model, see B. Hunt and C. Terry, *op. cit.*, pp. 593–4. The model is applicable to European options. The valuation of American options can be adapted to the use of the model.

13. The financial institution providing the product might “re-insure” the arrangement in the options market, so it will want to more than cover its costs of doing so.


15. This is a simplified account in several ways, including the fact that the swaps market sets its own rates, and interest settlements are based on exact days between dates rather than the assumption of equal-length quarters.
16. To consider why this is so, assume the yield curve has shifted upwards by 1%. In Figure 21.9, this would mean company A would have to pay 1% more on the floating-rate component of the swap, while the receipts from the swap are fixed.
