

Chapter 23 Risk Management

Chapter Overview

The *What Companies Do* opening feature talks about Google's large international business segment. The story starts at its second quarter 2011 earnings call when it was announced that Google had earned a profit jump of 32% with a net income of \$9 billion. But the interesting fact was that 54% of the earnings were generated in overseas markets. Google's CFO, Patrick Pichette, managed its extensive currency hedging program. The purpose of those hedging policies was to prevent large fluctuations in cash flows.

What Companies Do Discussion Questions:

1. What are the advantages and disadvantages of using hedging policies to prevent cash flow fluctuations?
2. What is interest rate exposure? How can a company reduce its interest rate exposure?

This chapter covers:

- 23-1. Overview of Risk Management
- 23-2. Forward Contracts
- 23-3. Futures Contracts
- 23-4. Options and Swaps
- 23-5. Financial Engineering

Technology

1. **Smart Video.** John Graham of Duke University discusses the costs and benefits of hedging.
2. **Smart Video.** Betty Simkins of Oklahoma State University talks about interest rate swaps.
3. **Smart Video.** David Childress, asset liability manager for Ford Motor Co. discusses interest rate risk and its impact on the firm's balance sheet.
4. **Smart Video.** Keith Woodward, vice president of finance for General Mills, explains that hedging commodities risk is very important to successfully doing business.
5. **Smart Concepts Video** demonstrates risk management, provides a step-by-step explanation of the costs and benefits of forward and futures contracts, and offers an example of forward pricing and arbitrage.
6. **Smart Solutions** provides a step-by-step solution to Problem 23-2.

After studying this chapter you should be able to:

- describe the types of risks that can adversely affect a company's cash flows and explain why companies might choose to hedge those risks
- calculate the price of a forward contract and illustrate how to use such a contract to hedge a risk exposure
- explain the differences between forward and futures contracts
- describe the basic features of options and swaps and explain how they can be used to hedge risk exposure.

Lecture Guide

Probably the only perfect hedge is in a Japanese garden. Risk management can't be perfect, but it can help stabilise a company's earnings and remove volatility from operations and investments. Forwards and futures have been used for a long time. Forwards were used by Flemish traders in the 12th century, while futures and options date back to the Amsterdam stock exchange in the 17th century. Futures were also used in the Osaka rice market in the late 17th century. Organised commodity exchanges were set up in Chicago and New York in the middle of the 19th century.

Figure 23.1 Risk Managers Report Increases in Common Risks Facing Their Companies

23-1 Overview of Risk Management

There have been a number of innovations in the area of risk management in the past few decades. In the early 1970s, for example, the abandonment of the gold standard and the move to floating rather than fixed exchange rates led to wide fluctuations in exchange rates – and a much greater need for foreign exchange futures.

Most believe the financial markets are better off with financial innovations. They have greatly lowered the cost of many financial transactions. For example, suppose a portfolio manager wanted to get out of the share market and into Treasury securities. Selling an entire portfolio would be very costly. It would be much less expensive to sell equity index futures.

23-1a Risk Factors

Risk management means managing a company's exposure to changes in factors like commodity prices, interest rates and exchange rates. Risk itself refers to a condition where there is a possibility that there will be an adverse deviation from what the firm hopes for. This in turn implies that some sort of expectation exists. A firm not only may need to manage these direct risks, but may also face secondary risks. For example, in the 1970s Laker Airways expanded because of a high number of British vacationers. The airline bought a fleet of DC10s, paid for in US dollars. Since its revenues were in pounds, this created an exposure to foreign exchange rate risk. When the dollar strengthened, revenues declined because there were fewer British vacationers, yet the company still had its dollar obligation for the airplanes.

23-1b The Hedging Decision

Hedging itself is a zero net present value project, but it can increase value for some firms. For hedging to do so, then either cash flows must increase or the discount rate must decrease. To impact cash flows, risk management decisions must either lower the company's transaction costs or improve its investment decisions.

- *Motivations for Hedging:*
 - Risk management can reduce the firm's transactions cost by reducing the probability of financial distress. A manager should ask what is the probability – high or low – of the firm becoming distressed? Are the costs of distress high or low? Firms that have high probabilities of distress or high costs associated with distress will benefit more from hedging than those with lower costs.
 - Risk management can also help ensure that enough internal funding is available for investments.
 - A firm may also wish to lock in project returns through hedging.
 - The firm can increase its cash flow by reducing its tax liability. The US has a convex tax structure – firms (and individuals) making more money pay higher percentages of their income in taxes.
 - Risk management can smooth out earnings, lowering the overall tax bill over time.
 - Hedging can increase debt capacity by smoothing out cash flows and making the company more attractive to lenders.

- A company can also reduce its financing costs by ‘playing the yield curve.’ This involves borrowing at a fixed rate, and then using a swap to convert payments in the early years to a floating rate. A firm could borrow where the yield curve is low and invest where it is high.
- *Student Involvement:* Ask students what today’s yield curve looks like, and what strategy would be likely to make money with the current yield curve.
- *Hedging Strategies:* This section also introduces some common hedging strategies.

Figure 23.2 Probability Distribution of Possible Cash Flows for a Corporation

Table 23.1 The Tax Incentive to Hedge

Figure 23.3 Why Do Companies Hedge?

23-2 Forward Contracts

Forward contracts are obligations to buy or sell specified amounts of a currency, commodity, coupon payment, etc. at a specified time in the future at a specified price. Note that forward contracts are the riskiest hedge – both parties bear default risk. On the other hand, forward contracts may be custom designed and can be entered into for longer periods of time than futures contracts. Note that the idea behind forward contracts was introduced in the previous chapter.

23-2a Forward Prices

In efficient markets there are no arbitrage opportunities. In other words, the forward price accurately reflects the cash flows of a forward contract with identical cash flows. The forward price is a function of the current or spot price, the risk-free rate of interest and the time remaining in the contract. This relationship is more complicated for assets that pay income, like a coupon bond, or that have storage costs, such as commodities.

23-2b Currency Forward Contracts

It is important to understand the relationship between spot and forward currency prices. Often a firm has an asset or liability in one currency and wishes to translate that value into its home country currency. Now, the differences in risk free rates in the two countries enter into the equation. This means that inflation is also a factor, since a country with a higher rate of inflation is likely to have a higher nominal risk free rate.

Table 23.2 Spot and Forward Exchange Rates

Figure 23.4 Payoff Diagram for the Buyer of a 6-Month Forward Contract on the British Pound

Figure 23.5 Payoff Diagram for the Seller of a 6-Month Forward Contract on the British Pound

23-2c Interest Rate Forward Contracts

Many companies use interest rate forward contracts, or forward rate agreements, in which cash flows based on a particular interest rate and principal amount are exchanged. Note that the notional amounts are not at further risk in such an arrangement; only the interest is exchanged.

Cash flows in FRAs are functions of the relevant reference rate, usually a well-known rate such as a Treasury rate or LIBOR, the forward rate and the length of the contract period. Forward and futures contracts can be used by a firm to protect against adverse changes in interest rates, which would allow the firm to lock in a future interest rate. Most firms are not in the business of speculating on interest rates. Derivatives contracts allow a firm to focus on their core business and not worry about changes in interest rates, currency or commodity price fluctuations.

23-3 Futures Contracts

This section begins with some basic definitions of the key terminology. Futures contracts are very similar to forwards, but the default risk is lower. The investor only has to worry about the creditworthiness of the exchange, not of the other party to the futures contract. A futures contract is like a series of forward contracts, settled daily instead of at the expiration of the contract. A futures contract is standardised, which reduces its transactions cost.

Table 23.3 Gold Futures Prices, 15 July 2011

Table 23.4 Examples of Exchange-Traded Futures Contracts

23-3a Hedging with Futures Contracts

Most futures contracts do not end in delivery of the commodity. Traders are more likely to 'unwind' a futures contract by taking an offsetting position – buying when they had previously sold or selling when they had previously bought. Studies have shown that there is a variety of corporate hedging policies. In general, large firms are more likely to hedge (perhaps because of greater sophistication of managers) than small firms. This is somewhat contradictory, since small firms generally are riskier and probably could benefit from hedging. A 1996 Tufano study looked at the hedging behaviour of 48 gold mining companies. About one in six firms hedged none of their output, while another one in six hedged more than 40% of their output. One company even hedged 85% of its output. The main differential in hedging policies was found to relate to the nature of management compensation. The greater management's per cent share of ownership, the larger the per cent of output was hedged. If management compensation contracts contained options or option-like features, then there was less hedging. This points to the fact that hedging reduces total risk, a concern of a manager with a large stake in the company. This hedging will not necessarily benefit investors who hold diversified portfolios.

A firm should not necessarily hedge in the same way as its competitors. For example, a AAA rated firm, with plenty of borrowing capacity, has less reason to hedge than a B rated firm that might find future borrowing difficult if it is unable to generate sufficient internal funds. Discuss basis risk, cross-hedging, and tailing the hedge. This section also introduces the two main ways to hedge futures:

- *Hedging with Foreign Currency Futures*
- *Hedging with Interest Rate Futures*

23-3b Concerns When Using Futures Contracts

This section discusses the major concerns when using futures contracts:

- *Basis Risk*: Basis is the difference between the futures price and the spot price. Risk arises from unanticipated changes in the basis.
- *Cross-Hedging*: If the underlying securities have different characteristics, then cross hedging occurs.
- *Tailing the Hedge*: This is purchasing enough futures contracts to hedge the risk exposure, but not so many that the position is over-hedged.
- *Delivery Options*: There are many different delivery options on futures contracts. These options for delivery affect the option price and are very important for firms planning to take or make delivery.

23-4 Options and Swaps

23-4a Options

Options can also be used to hedge successfully. One advantage of options is that they can be structured to provide whatever payoff is desired. A firm can design an option contract that pays off when prices rise, or prices fall, or stay the same or move within a particular range. This section also has a continuation of a fictitious firm and how it can undertake hedging with both *currency* and *interest rate* options.

23-4b Swaps

Swaps are also a series of forward contracts, but they have periodic settlements, say quarterly, monthly or annually, rather than only at the expiration of the contract. They still have default risk, but it lies in between the risk of a forward and a future. There may not be an actual exchange of cash flows – often only the net cash flow is actually exchanged. Often in case of default, the other party is released from the swaps contract.

Swaps can be used creatively. A recent report suggested that the Italian government used swaps to hide the magnitude of its budget deficit. A swaps contract allowed Italy to reduce its deficit to 2.7% of gross domestic product, which allowed it to qualify for the European Monetary Union. (The budget deficit had been 6.7% of GDP the previous year.) The swaps contract locked in paper gains on a foreign currency bond issue. It used a combination of exchange rates and interest rates that meant it would receive more cash initially than it would have otherwise over the life of the contract. Italy paid back the excess cash when the swap contract matured in 1998, after Italy had been chosen for the monetary union. Italian officials denied any wrongdoing in arranging the swap.

Figure 23.6 Typical Structure of a Fixed-for-Floating Interest Rate Swap

Figure 23.7 Semiannual Net Cash Flow for the Fixed-Rate Payer in a Fixed-for-Floating Swap with a Notional Principal of \$10 Million

Figure 23.8 Semiannual Net Cash Flow for the Floating-Rate Payer in a Fixed-for-Floating Swap with a Notional Principal of \$10 Million

- *Currency Swaps:* Today it is difficult not to deal with foreign currencies – firms may have customers or suppliers in a foreign country. A firm may wish to hedge to reduce its foreign currency exposure. Exchange rates fluctuate for reasons beyond the firm's control. The firm may wish to use derivatives to hedge its currency risk, so it can focus on its core business and not be concerned about currency fluctuations on profits, assets and liabilities. Usually, a financial intermediary arranges swaps.
- *Student Involvement:* Ask students which kinds of companies would like to change from floating rate to fixed rate financing and vice versa. For example, a manufacturing firm with floating rate debt might want to lock in an interest rate so it can be sure of its future interest expenses. On the other hand, a bank with floating rate liabilities (demand deposits) might want floating rate loans (assets) to match its floating rate liabilities.

23-5 Financial Engineering

Note that regulation has not kept pace with derivative development. The current joke is that derivatives regulation is like blowing a whistle to keep away tigers. So far, it's working – there are no tigers around. So far, whistling has been inexpensive – this may change, particularly with high profile problems like Enron's bankruptcy and its aftermath.

This is a constantly changing area. The fastest growing upper level corporate job is that of chief risk officer. Most companies won't say very much about how they manage risk – some won't even say if they have a chief risk officer. However, this task is becoming more and more important in the corporate world.

Risk Management Summary

Risk management is an area that firms must play close attention to. A variety of specialised instruments have been developed to help firms manage their risk.

Chapter 23 Resource Articles

'Where the Risk Went,' *Business Week*, 28 October 2002. This article looks at new financial tools that shift some of the risk burden from banks to other institutions. It mentions securitisation, derivatives, credit default swaps, syndicated loans, surety bonds and computerised risk gauges.

'EDS Isn't Alone in Betting on Rising Stock,' *Wall Street Journal*, 27 September 2002. To hedge against the cost of share repurchase programs, many firms bet on rising stock price through put options and forward purchase agreements. In a falling stock market, these arrangements can backfire.

'How EDS Rolled Dice – and Lost,' *Wall Street Journal*, 26 September 2002. This article relates how EDS's attempt to prevent option grants from diluting existing shareholders backfired when its stock price declined.

'Small Business Try Hand At Forex,' *Wall Street Journal*, 8 August 2011. This article discusses the trend in small businesses of using foreign exchange to hedge currency fluctuations. It shows how even small businesses are entering the global market and wanting to protect themselves.

Enrichment Exercises

Show the class a 60-minute PBS special, 'The Trillion Dollar Bet.' This program talks about the development of the Black-Scholes model, including interviews with Myron Scholes and Robert Merton (who added to the model) who earned Nobel prizes for their work. It discusses the rise and fall of Long Term Capital Management (LTCM), a hedge fund sponsored in part by the option pricing model developers. LTCM earned extraordinarily high returns in its early years, but then lost billions when the market moved in the wrong direction. This video can be ordered from pbs.org.

Combine risk management with efficient market hypothesis. Ask students if it is true that in efficient markets, hedging shouldn't make a difference – the company will lose money sometimes, make money sometimes and on average break even. Most students will recognise that this statement is true, but the firm could go bankrupt if it had a string of losses before the law of averages balanced some of those losses with successes.

Answers to Concept Review Questions

1. Hedging occurs when a firm uses derivative contracts to offset existing risks in the business. Speculation involves placing a bet on the direction that an underlying asset will move. By not hedging a risk, a company is effectively betting the market will not move against it.
2. Derivative securities may have acquired a questionable reputation because of a few well-publicised misuses of derivatives. For example, Orange County in California had financial problems because of an employee's unwarranted speculation in derivatives. There has been recent focus on the misuse of credit derivatives from some of the world's leading financial companies. This type of news can only drag down the public's perception
3. If Equation 23.2 does not hold, an arbitrageur could earn a riskless profit by selling the forward contract if the contract price is too high based on the model or buying the forward contract if it is too low. For example, if the contract will provide less income or costs more to store, the forward price may be too high and an arbitrageur could profit. Whatever transaction arbitrageurs undertake in the forward market, they will take an offsetting position in the underlying asset.
4. Forward cash flows occur at a specified time in the future – conditions may have changed by the time the forward contract must be fulfilled. Spot transactions take place today
5. A futures contract is settled daily. This means that if the asset moves in the wrong direction for investors, they may be required to put up additional money to satisfy their broker's margin account requirements. If the investor does not put up additional cash, then the futures contract may be

closed out at a loss to the investor. A forward contract is settled only once, at the expiration of the contract.

6. The daily settlement feature tends to reduce default risk – the investor who is at the losing end of the contract must add cash to his/her account, or else the broker will close out the position. This prevents the problem of reaching maturity and finding out that one party cannot deliver.
7. An interest rate swap is just a portfolio of *FRAs* because it is just a sequence of payments through time where the payments depend on the difference between a fixed and a floating interest rate. A single forward rate agreement is one payment that is based on the difference between two interest rates, so a sequence of forward rate agreements spread over time is similar to a swap.
8. A corporation may choose to hedge with forwards, futures, or swaps even if it can keep its upside potential by hedging with options. Hedging with options does preserve some upside potential, but it is expensive because the firm has to purchase the options by paying the option premium. With futures, forwards, and swaps, no cash is required up front (except for margin requirements with futures).
9. A firm might prefer an engineered solution when the off-the-shelf solutions do not precisely match the firm's risk exposure (for example, timing mismatches, or mismatches between the risk being hedged and the underlying assets backing the derivative used to hedge the risk).

Answers to Self-Test Problems

ST23-1. A certain commodity sells for \$150 today. The present value of the cost of storing this commodity for one year is \$10. The risk-free rate is 4%. What is a fair price for a one-year forward contract on this asset?

A: Use equation 23.2 to solve this problem. $F = (150 + 10)(1.04) = 166.40$

ST23-2. The spot exchange rate is \$1.6666/£. The risk-free rate is 4% in Australia and 6 per cent in the United Kingdom. What is the forward exchange rate (assume a 1-year contract)?

A: Use equation 23.3 here, but remember that we need to express the exchange rates in terms of foreign currency per unit of domestic currency. If we treat the \$ as the domestic currency, then the spot rate is $1/(\$1.6666/£)$ or $£0.6000/\$$. So we have

$$F = 0.6000(1.06)/1.04 = 0.6115.$$

Answers to End-of-Chapter Questions

Q23-1. Historically, what types of risk were the focus of most companies' risk-management practices?

A23-1. In the past, companies tended to focus on minimising firm-specific risks dealing with their own operations. These risks included workers' compensation claims, product recalls, product liability claims, and fire or flood losses. However, as interest rates, currency exchange rates and commodity prices have become more important to a company's profitability, and financial managers have been more concerned with hedging these risks.

Q23-2. Distinguish between the motivations for purchasing insurance and the motivations for hedging market-wide sources of risk.

- A23-2.** The motivations for purchasing insurance are the benefits gained by transferring certain types of risk exposures to an insurance company, which is better able to evaluate and price these risks. As a result of its expertise, the insurance company has a comparative advantage in bearing these risks. On the other hand, the motivations for hedging market-wide sources of risk are increasing firm value, reducing taxes, and reducing the likelihood of financial distress.
- Q23-3.** Distinguish between transactions exposure and economic exposure.
- A23-3.** Transactions exposure is the risk associated with potential changes in prices that affect the value of specific transactions, while economic exposure is the risk associated with potential changes in prices that affect all of a firm's cash flows.
- Q23-4.** In what way can hedging reduce the risk of financial distress? How might reducing the risk of financial distress increase company value?
- A23-4.** Hedging can reduce the risk of financial distress by decreasing the probability that the company's cash flows will decline to the point of financial distress. By reducing this risk, the company avoids the costs of financial distress, thereby increasing company value. Among the costs of financial distress that are avoided by hedging are contracting costs involving relationships with creditors, suppliers, and employees. In addition, hedging to reduce the risk of financial distress may increase revenue for companies that sell products with warranties since service contracts are more likely to be honoured if the company has a reduced likelihood of financial distress.
- Q23-5.** Explain how hedging can reduce a company's tax liability.
- A23-5.** Hedging can reduce a company's tax liability if the company's tax function is convex, meaning that tax rates rise with income. If a company's tax function is convex, then its expected tax liability will be higher if it does not hedge its risk exposures.
- Q23-6.** Why do closely held companies tend to hedge more than companies with diffuse ownership?
- A23-6.** Closely held companies are more likely to hedge because their owners have invested a greater proportion of their wealth into the company and are therefore, less diversified. These owners tend to hedge more in order to minimise the risk exposure of the company, and ultimately, the risk exposure of their investments.
- Q23-7.** How can hedging make it easier to evaluate a manager's performance?
- A23-7.** A company's performance is determined by the performance of its managers and the impact of external factors. When a company hedges, the exposure the company has to these external risk factors is minimised. Therefore, a manager's performance can be more easily evaluated when a risk management program is in place, as his or her performance is much more closely aligned with the company's overall performance than it otherwise would be.
- Q23-8.** What are the advantages of using exchange-traded derivatives to hedge a risk exposure? What are the advantages of over-the-counter derivatives?
- A23-8.** Exchange-traded derivatives offer the advantage of having low transaction costs and high liquidity. Over-the-counter derivatives have much more flexible contract terms and can be customised to meet the needs of the individual market participants.

- Q23-9.** Conceptually, how do we determine the fair forward price for an asset? What are the necessary assumptions to arrive at a fair forward price?
- A23-9.** The forward price for an asset can be determined by comparing the forward contract with an alternative investment strategy that has identical cash flows. The fair forward price is that which makes the forward contract have a net present value of zero, therefore eliminating any arbitrage opportunities. In order to arrive at the fair forward price, it is assumed that market participants are able to borrow and lend at the risk-free rate, that transactions costs are not applicable, that there are no costs associated with short-selling, and that all market participants are able to use the proceeds from short selling.
- Q23-10.** Conceptually, what are the differences between Equations 23.1, 23.2, and 23.3? Which equation would you use to determine the fair forward price for an asset that does not earn any income but is costly to store, such as gold or silver? How would you modify the equation?
- A23-10.** Equations 23-1, 23-2 and 23-3 differ in that each is used to determine the fair forward prices for assets with different attributes and cash flows. Equation 23-1 is suitable for assets that pay no income and do not cost anything to store, while equation 23-2 accounts for income and storing costs. Equation 23-3 is appropriate for determining the fair forward price of a currency contract. In order to determine the fair forward price for an asset that does not earn income but is costly to store, we would use equation 23-2. The equation would have to be modified to include the present value of the cost to store the asset for the life of the forward contract, without considering the present value of the income to be paid by the asset, since this particular asset does not earn any income.
- Q23-11.** Describe the features of a futures contract that make it more liquid than a forward contract.
- A23-11.** Futures contracts are standardised and have high trading volume, which makes them more liquid than forward contracts. Futures have high trading volume in part because futures contracts are fungible.
- Q23-12.** Explain the features of a futures contract that make it have less credit risk than a forward contract.
- A23-12.** Futures contracts are exchange-traded, which makes them have less credit risk than forward contracts, as the exchange is the counter-party in all transactions and is highly credit-worthy. Futures also have lower levels of default risk due to the marking-to-market feature of futures contracts. Marking-to-market involves the daily cash settlement of all contracts, which forces contract parties to realise any losses or gains immediately.
- Q23-13.** Why is fungibility an important feature of futures contracts?
- A23-13.** Given that futures contracts are fungible, the buyer or seller of a futures contract can close out his/her position by taking an offsetting position in an identical contract. As a result, the same buyers and sellers are able to enter into new contracts, which create higher trading volume and greater liquidity in the futures market.
- Q23-14.** Describe the delivery process for futures contracts. Why does delivery rarely take place in futures contracts?
- A23-14.** Futures contracts generally allow delivery to take place any time during the month in which the settlement date falls. At some point during this month, if delivery is to take place, the seller notifies the clearinghouse of his or her intent to deliver on the contract. At that point, the

clearinghouse informs the buyer with the contract that he or she will be receiving an acceptable instrument for delivery within the next two days. The actual delivery takes place when the seller provides the buyer with the deliverable instrument in exchange for the futures price. If the instrument delivered is different from the specific underlying security in the futures contract, the price the seller receives for the futures contract will be adjusted by conversion factors that account for the differences in these securities. However, delivery rarely takes place in futures contracts due to the fungible features of the contracts.

Q23-15. Why is a call option on an interest rate called an interest rate cap and a put option called an interest rate floor?

A23-15. A call option on an interest rate is an interest rate cap because it effectively limits the borrowing costs of the company that buys the cap. Any increase in interest rates above the exercise price of the cap results in positive cash flows for the buyer of the cap. These positive cash flows offset the increase in borrowing costs experienced by the company in their underlying risk exposure. Similarly, a put option on an interest rate is called an interest rate floor because it effectively limits the extent to which a company is hurt by lower interest rates.

Q23-16. Explain how a fixed-for-floating swap can be considered a portfolio of forward contracts on 6-month discount bonds.

A23-16. When two parties enter into a fixed-for-floating swap, they are agreeing today to exchange payment obligations at a series of fixed dates in the future. This can be considered a portfolio of forward contracts, since the payment exchange at each date in the future represents the fulfillment of one forward contract.

Q23-17. Go to the CBOT website (www.cmegroup.com/company/cbot.html), and determine the contract specifications for soybean meal futures and 10-year US Treasury note futures. Apart from the difference in the type of asset, what is the difference between the two contracts in terms of what qualifies as deliverable grades?

A23-17. Soybean meal futures do not have a variety of deliverable grades. In fact, there is only one grade of soybean meal with minimum protein of 48% that is suitable for delivery. On the other hand, 10-year US Treasury note futures have a range of deliverable grades. Any US Treasury note with a maturity of at least 6½ years from the first day of the delivery month is suitable for delivery on this futures contract.

Q23-18. Go to the CME Group website (www.cmegroup.com/company/cbot.html), and determine the minimum initial margin requirements for speculators in the contracts traded on that exchange. Which contracts have the smallest margin requirements? Which contracts have the largest requirements? Why do you suppose these contracts have such different margin requirements?

A23-18. In general, the margin requirement will depend on the volatility of the underlying asset. The higher the volatility of the underlying asset, the higher the margin required. For example, the margin required for a futures contract on 5,000 bushels of corn is \$400, and the margin requirement for a 5,000 bushel soybean contract is \$850.

Answers to End-of-Chapter Problems

Forward Contracts

P23-1. Suppose that an investor has agreed to pay \$94,339.62 for a one-year discount bond in one year. Two years from now, the investor will receive the bond's face value of \$100,000. The current effective annual risk-free rate of interest is 5.8%, and the current spot price for a two-year discount bond is \$88,999.64. Has the investor agreed to pay too much or too little? How might an arbitrageur capitalise on this opportunity?

A23-1. Fair forward price = $\$88,999.64 \times (1 + 0.058) = \$94,161.62$.

The investor is paying too much. An arbitrageur can capitalise on this opportunity by selling the bond forward one year for \$94,339.62, borrow \$88,999.64 at 5.8% interest, and buy the two-year discount bond. In one year, the investor would deliver the bond for \$94,339.62, pay off the loan for \$94,161.62, and keep \$178. Note that this did not require any upfront investment by the arbitrageur.

P23-2. Company A's shares will pay a dividend of \$5 in three months and \$6 in six months. The current share price is \$200, and the risk-free rate of interest is 7% per year with monthly compounding for all maturities. What is the fair forward price for a seven-month forward contract?

A23-2. The fair forward price is:

$$F = \left(200 - \frac{5}{\left(1 + \frac{0.07}{12}\right)^3} - \frac{6}{\left(1 + \frac{0.07}{12}\right)^6} \right) \times \left(1 + \frac{0.07}{12} \right)^7 = 197.16$$

P23-3. The current price of gold is \$288 per troy ounce. The cost of storing gold is \$0.03/oz per month. Assuming an annual risk-free rate of interest of 12% compounded monthly, what is the approximate futures price of gold for delivery in four months?

A23-3. The fair forward price is

$$F = \left(288 + \sum_{t=1}^4 \frac{\$0.03}{\left(1 + \frac{0.12}{12}\right)^t} \right) \times \left(1 + \frac{0.12}{12} \right)^4 = \$299.82$$

P23-4. Following is the current yield to maturity on Treasury notes of various maturities:

Time to Maturity	Yield
Months %	
1	5.0
3	5.2
6	5.4
9	5.8

Assuming monthly compounding, what should the forward interest rate of a three-month Treasury note be if it is to be delivered at the end of three months? What if it is to be delivered at the end of six months?

- A23-4.** We want to determine the forward interest rate on a three-month bond that will be delivered in three months. The underlying asset here is a Treasury note that matures six months from now. First, determine that bill's spot price:

$$\text{Price} = 1,000 \div (1 + 0.054/12)^6 = 973.42.$$

We can now determine the forward price of this bond using Equation 23.1.

$$F = 973.42 (1 + 0.052/12)^3 = 986.13$$

Finally, we can determine the forward interest rate by determining the rate of return that an investor will earn if they purchase this bond at the forward price in three months and receive \$1,000 three months later.

$$\begin{aligned} 1,000 &= 986.13 (1 + r/12)^3 \\ r/12 &= [(1,000/986.13)^{1/3}] - 1 = 0.0046 \\ r &= 0.056 = 5.6\%. \end{aligned}$$

An alternative way to arrive at this number is to recognise that an investor with a six-month investment horizon could adopt one of two strategies. First, the investor could simply buy the six-month Treasury note and earn 5.4% for six months. Second, the investor could buy a three-month Treasury note (earning 5.2% for three months) and a futures contract on a 3-month Treasury note (earning $r\%$ for the second three-month period). Both of these strategies are risk-free, so both should offer the same rate of return. Therefore we have

$$\begin{aligned} (1 + 0.054/12)^6 &= (1 + 0.052/12)^3 (1 + r/12)^3 \\ r &= 0.056 = 5.6\% \end{aligned}$$

The forward rate on a three-month Treasury note to be delivered in six months can be found using similar logic.

$$\begin{aligned} (1 + 0.058/12)^9 &= (1 + 0.054/12)^6 (1 + r/12)^3 \\ r &= 0.066 = 6.6\% \end{aligned}$$

- P23-5.** Using the information in Table 23.2, determine whether the three-month forward rate on euros is fair if the annualised yield for risk-free borrowing over the next three months is 8% in Europe and 5% in the United States. If the price is not fair, how could you capitalise on the arbitrage opportunity? What is the potential profit? Assume monthly compounding for borrowing and lending.

- A23-5.** The spot rate of exchange between euros and dollars is € 0.9009 / \$. Interest rate parity (Equation 23.3) implies that the fair forward rate should be
- $$F = 0.9009(1 + 0.08/12)^3 / (1 + 0.05/12)^3 = 0.9076$$

In Table 23.2, the three-month forward rate is listed as 0.8902. We could say that the actual forward rate is 'too low' or we could say that the right hand side of the equation above is 'too high'. This latter way of thinking about the problem leads to the conclusion that either the interest rate in Europe is too high, or the rate in the US is too low. To make an arbitrage profit from this discrepancy, a trader could borrow in the US, convert dollars into euros at the spot rate, invest in Europe, and then convert back into dollars at the forward rate when the European investment matures. For instance, suppose an investor borrows \$1 million in the US at 5% for three months. Converting these into euros, the investor will have €900,900 to invest at 8% for three months.

At the end of that period, the investment will have grown to

$$900,900(1 + 0.08/12)^3 = €919,038$$

Now the investor converts these to dollars at the quoted forward rate of 0.8902. After converting, the investor has \$1,032,395. From this total, the investor must repay the US loan:

$$\$1,000,000(1 + 0.05/12)^3 = \$1,012,552$$

This leaves an arbitrage profit of \$19,843.

- P23-6.** A US car importer is expecting a shipment of custom-made cars from Britain in six months. Upon delivery, the importer will pay for the cars in pounds. Using the information in Table 23.2, suggest a hedging strategy for the importer. Explain the consequences for the spot market transaction and the forward market transaction if the US\$/£ spot exchange rate increases over the next six months.
- A23-6.** The importer can hedge this exposure by buying pounds forward at US\$1.6845 per pound. If the US\$/£ exchange rate increases, the dollar cost of paying the UK company rises, but the US company avoids this increase because it has locked in a forward contract.
- P23-7.** Suppose that KF Exports enters into a FRA with Interfirst Bank with a notional principal of \$50 million and the following terms: in six months, if LIBOR is above 6%, KF will pay Interfirst according to the standard FRA formula. On the other hand, if LIBOR is less than 6%, Interfirst will pay KF. If LIBOR is 5.5% in six months, who pays and how much will the company pay? What if LIBOR is 6.5%?
- A23-7.** The cash flow for an FRA is the notional principal $\times (r_s - r_F) \times D/360$, all divided by $1 + (r_s \times D/360)$.
- Notational principal: \$50 million
 R_s , reference rate: LIBOR
 R_F , forward rate established at contract origination: 6%
 $D = 180$ days, 6 months
- If LIBOR is 5.5%
 Cash flow = $[50,000,000 \times (.055 - .06) \times 180/360] / [1 + (.055 \times 180/360)] = -121,655$
 Interfirst will pay KF \$121,655
- If LIBOR is 6.5%
 Cash flow = $[50,000,000 \times (.065 - .06) \times 180/360] / [1 + (.065 \times 180/360)] = 121,065$
 In this case, KF will pay Interfirst \$121,065.

Futures Contracts

- P23-8.** An investor purchases one gold futures contract for delivery in August 2011. Using the information in Table 23.3, determine the settle price for the contract on 15 July 2011. What is the total futures price for the contract? If the settle price on the next trading day is \$1,592/oz, will the investor have money deposited into his margin account or withdrawn? How much? Suppose that the investor eventually closes out the position by selling at a price of \$1,594/oz. How much is his profit or loss?
- A23-8.** The settlement price on 15 July 2011, for a contract with delivery in August 2011 is \$1,590.10, for a total futures price of \$159,010. If the price goes to \$1,592 the next day, the trader with the long position will have a gain of \$1.90 and \$190 deposited into his/her account. If the trader

ultimately closes out the position at \$1,594, the total profit will be \$3.90 or \$390.

- P23-9.** Consider the following scenarios, determine how to hedge each scenario using bond futures, and comment on whether it would be appropriate to hedge the exposure.
- A bond portfolio manager will be paid a large bonus if her \$10 million portfolio earns 6% in the current fiscal year. She has done very well through the first nine months. However, she is concerned that interest rates might increase over the next few months.
 - The manager of a company is selling one of its warehouses. The deal will close in two months. The manager plans to buy six-month Treasury notes when the company receives payment for the warehouse space, but the manager is worried that interest rates might decline in the next two months.
 - Sam Blackwell plans to retire in a year. Upon retirement, he will be paid a lump sum based on the value of the securities in his defined-contribution retirement plan. Sam's portfolio consists largely of Treasury bonds, and he is worried that interest rates will be increasing in the coming year.
- A23-9.**
- The portfolio manager could sell bond futures to protect herself from a decline in the value of the portfolio. However, the portfolio's investors are unlikely to benefit from the hedge, so it is probably not appropriate.
 - The manager can buy bond futures to lock in a yield on Treasury notes. Whether hedging this risk makes sense or not depends on its impact on the risk of financial distress, its impact on taxes, whether the firm is closely held, and so on.
 - Sam can sell bond futures to protect the value of his bond portfolio and he probably should hedge if he is risk averse.

Options and Swaps

- P23-10.** Chipman Products Company will suffer an increase in borrowing costs if the 13-week US Treasury bill rate increases in the next six months. Chipman Products is willing to accept the risk of small changes in the 13-week T-bill rate but wishes to avoid the potential losses associated with large changes. The company plans to hedge its risk exposure using an interest rate collar. If the company buys a call option on the 13-week T-bill rate with a strike price of 60 and sells a put option with a strike price of 50, describe how this strategy will limit the company's exposure to changes in the T-bill rate. The premium on the call is 0.75, and the premium on the put is 0.85. What is the company's profit (or loss) in the option market if the T-bill rate is 4.5% in five months? If the T-bill rate is 5.5%? If the T-bill rate is 6.5%?
- A23-10.** By buying a call option on the 13-week T-bill rate, the company is protected from increases in its borrowing costs above a T-bill rate of 6.0%. By selling a floor, the company forgoes the benefits of a decrease in its borrowing costs below a T-bill rate of 5.0%. The latter helps to pay for the former. If the T-bill rate is 4.5%, the put option will have a negative payoff at expiration of \$500. The premiums associated with the options netted \$10, so the option position would have a net loss of \$490. If the T-bill rate is 5.5%, we would have a net profit of \$10. If the T-bill rate is 6.5%, our profit would be \$510.
- P23-11.** Go to the CBOT website (www.cmegroup.com), and determine the contract specifications for Dow Jones Industrial Average futures. (This is referred to as the Big Dow DJIA (\$25) Futures contract). Determine the current futures price for the next available contract month. What would your profit or loss be if you bought one contract today and the Dow Jones Industrial Average increased by 100 points before the last settlement date?
- A23-11.** Internet exercise – answers will vary.
- P23-12.** Company A, based in Switzerland, would like to borrow US\$10 million at a fixed rate of interest. Because the company is not well known, however, it has been unable to find a willing

US lender. Instead, the company can borrow SF17,825,000 at 11% per year for five years. Company B, based in the United States, would like to borrow SF17,825,000 for five years at a fixed rate of interest. It has not been able to find a Swiss lender. However, it has been offered a loan of US\$10 million at 9% per year. Five-year government bonds are yielding 9.5% and 8.5% in Switzerland and the United States, respectively. Suggest a currency swap that would net the financial intermediary 0.5% per year.

A23-12. One possible arrangement is

Annual payment by Company A to FI: 10.25% of US \$10,000,000
Annual payment to Company A from FI: 11% of SF17,825,000

Annual payment by Company B to FI: 10.25% of SF17,825,00
Annual payment to Company B from FI: 9% of US \$10,000,000

Net cash flow to FI: 1.25% of US \$10,000,000 minus 0.75% of SF17,825,000

P23-13. Citibank and ABM Company enter into a five-year interest rate swap with a notional principal of \$100 million and the following terms: every year for the next five years, ABM agrees to pay Citibank 6% and receive from Citibank LIBOR. Using the following information about LIBOR at the end of each of the next five years, determine the cash flows in the swap.

Year	LIBOR (%)
1	5.0
2	5.5
3	6.2
4	6.0
5	6.4

A23-13. The cash flows would be

Year 1: Net payment to Citibank of \$1,000,000
Year 2: Net payment to Citibank of \$500,000
Year 3: Net payment to ABM of \$200,000
Year 4: Zero net payment
Year 5: Net payment to ABM of \$400,000

P23-14. Based on the type of swap ABM entered into in the previous problem, what type of liabilities do you think ABM has? Long term or short term?

A23-14. ABM is paying fixed and receiving floating suggesting that they are using the floating rate cash inflows to pay their short-term liabilities.

Answer to MiniCase

Risk Management

Basic International Group has been involved in international trade for the past four years. Recently the CEO has come to realise that Basic needs better risk management and she asks you to investigate ways to manage risk through hedging. You remember that derivative securities, including forwards, futures, options, and swaps, are the financial instruments commonly used for hedging and risk management. However, to gain more insight into risk management you decide to answer the following questions.

Assignment

1. What are the types of risk factors that a company faces?
2. If risk aversion cannot explain why companies choose to hedge, then what are the motivations?
3. Explain how a company's management can limit risk exposure through using a forward contract. What types of forward contracts are available?
4. What are the differences between forwards and futures contracts?
5. How do managers use futures contracts to limit risk exposure?
6. How do managers use options to limit risk exposure?
7. How do managers use swaps to limit risk exposure?

Answers

1. The chapter discusses three types of risk factors; interest rate risk, transaction exposure, and economic exposure. A company is exposed to interest rate risk if a change in the level of interest rates adversely affects the cash flows of a company. Interest rate risk is the risk of suffering losses as a result of unanticipated changes in market rates of interest. The next type of risk pertains to transaction exposure, defined as the risk that a change in prices will negatively affect the value of a specific transaction or series of transactions. Third, there is economic exposure, defined as the risk that a change in prices will negatively impact the value of all cash flows of a company.
2. According to modern hedging theory, value-maximising firms hedge because hedging can increase firm value in several different ways. For most companies, however, the principal reason for hedging is to reduce the likelihood of financial distress. Reducing the likelihood of financial distress benefits the company by also reducing the likelihood it will experience the costs associated with this distress. In addition to these potential cost savings, hedging may increase revenue for firms that sell products with warranties or service contracts. Hedging may also reduce a firm's expected tax liability. As another benefit, closely held firms are more likely to hedge risk exposures because owners of the company have a greater proportion of their wealth invested in the company. Also, a benefit of hedging is that it makes it easier for the board of directors and outsiders to evaluate the performance of managers. Absent an effective risk-management program, it is difficult to disentangle company performance due to the manager's performance from company performance due to external factors. Finally, even though shareholders can hedge the exposures they face as a result of owning shares in a risky company, there are some circumstances under which it may be less costly for the company to minimise risk than for the shareholders to hold a diversified portfolio.
3. Managers can use forward contracts to lock in prices today for a future contract. Forward contracts include (a) currency forward contracts, which involve exchanging one currency for another at a fixed date in the future, and (b) interest rate forward contracts, where the underlying asset in an interest rate forward contract is either an interest rate or a debt security.
4. Like a forward contract, a futures contract involves two parties agreeing today on a price at which the purchaser will buy a given amount of a commodity or financial instrument from the seller at a fixed date some time in the future. In contrast to a forward contract, a futures contract is an exchange-traded contract that promises the delivery of a specified volume of a commodity or financial instrument on a standardised date of the month in which the contract expires.

5. Futures contracts, like forward contracts, are also used for hedging. There are futures markets for metals, foreign currencies, interest rates, stock indexes, and commodities. Long hedges can be created to offset an underlying short (sold) position. Short hedges can be created to offset an underlying long (purchased) position.
6. A key feature of an option as a hedging tool is that it provides protection against adverse price risk (an investor has the right to exercise the option if price changes make it optimal to do so) without having to forfeit the right to profit if the price on the underlying commodity moves in the investor's favour (in which case, the investor allows the option to expire unexercised).
7. In a swap contract, two parties agree to exchange payment obligations on two underlying financial liabilities that are equal in principal amount but differ in payment patterns. Investors use swaps to change the characteristics of cash flows, most often to change the characteristics of cash outflows. Similar to forward contracts, swap contracts are over-the-counter instruments and subject to default risk. An interest rate swap is the most common type of swap transaction. In a typical interest rate swap, one party will make fixed-rate payments to another party in exchange for floating-rate payments. This is often called a fixed-for-floating interest rate swap. The second most common type of swap contract is the currency swap, in which two parties exchange payment obligations denominated in different currencies.