# 27
# Managing Risk

## INTRODUCTION

This is the first of two chapters in the book dealing directly with risk management. Businesses face risk every day and it is not possible to earn significant returns for stockholders without taking risk. However, managers would like to reduce or eliminate the kinds of risk that does not give additional returns for taking the risk. These types of risk may relate to key inputs like raw materials, the main products of the business, or financial variables like interest rates or foreign exchange rates. Risk reduction of controllable risk allows financial managers to worry about the things that are worth worrying about and they are in the best position to handle. This chapter focuses on business related risk from commodity prices and interest rate changes. Thanks to financial innovation and development of financial derivatives, corporate financial managers have considerable flexibility in deciding the kind of risk they want to be exposed to and the kind of risk they want to hedge.

Hedging offsets risk and is accomplished with futures, forward contracts, options or and often with custom designed derivatives. Risk management through hedging with appropriate financial tools is the focus of this chapter. The primary purpose of hedging is to control individual risks thereby controlling a firm's total risk. Such hedging techniques are part and parcel of today's financial manager's tool book. The point of hedging is to minimize the risks the manager is not equipped to handle. Typically hedging involves finding the number of units of an asset (or liability) that is needed to offset changes in the value of an obligation (or asset) and then taking the appropriate derivative position to reduce or eliminate the risk.

## KEY CONCEPTS IN THE CHAPTER

**Rationale for Managing Risk:** Should managers manage risk? This is a fundamental question that needs to be answered. It might not be obvious, but transactions undertaken solely to reduce risk do not necessarily add value to the firm. The reasons for this are two fold. First, most risk management transactions result in a zero sum game. For example, a farmer may hedge his risk by selling forward his crop. Assume a food processing company takes the other side of the hedging transaction. Obviously the farmer's gain (loss) will be the food processing company's loss (gain). In other words, the hedging transactions do not create any wealth. It is unlikely that one firm will come out ahead every time.

The second reason why hedging does not add value is the fact that individual shareholders can either diversify the risk away or hedge the risk directly. A shareholder of a steel manufacturer can protect herself from adverse effects of iron ore prices, if she so chooses, by hedging in the market. She could very well buy shares of an iron mining company or she may well choose not to

hedge because she prefers speculate on the iron ore prices falling. As managers cannot divine the wishes and desires of all the shareholders of the company, they are not doing any big favor for the shareholders when they take hedging actions, which might not be in the best interests of the all the shareholders.

There are some reasons why risk management may make sense. Any risk management that reduces variability in cash flows and thus risk of financial distress could be very valuable. This facilitates better management of operations, R & D, etc. and enable the managers to concentrate on what the firm does well. Another possible benefit of hedging is that it motivates managers better as managers do not have to worry about factors beyond their control. This also helps in better monitoring and rewarding of managerial performance.

Empirical evidence on hedging appears to be mixed. Some firms do and some do not. Most companies buy insurance against catastrophic disasters and hedge against raw material price swings, and currency fluctuations.

**Insurance:** One simple way of hedging some kinds of risk is to go out and buy insurance. Insurance as a way of reducing or hedging risk has been around for a long time. However, the kind of risk, which can be insured, is rather limited. This depends on the type of risk and the extent to which insurance companies have a relative advantage in dealing with it. Before they underwrite insurance for any risk, insurance companies would like to have a reasonable estimate of the probability of the risk-causing event. They would also like to have a large enough pool of customers seeking the insurance for the risk. If these two conditions are not satisfied, the insurance will be too costly to write. It is unlikely that you will want to insure risks for which the premium is too expensive. Insurance will also be inefficient if the presence of insurance gives you less incentive to reduce the risk yourself.

In general, the insurance companies have the following relative advantages:

- They are skilled at estimating risks.
- They are skilled at advising on reducing risk.
- They can pool (or diversify) risks.

Insurance companies also face some disadvantages. These include:

- They have to overcome their administrative costs, including legal costs of disputes.
- They encounter the *adverse selection* problem, where those at greater risk are more likely to buy insurance.
- *Moral hazard* is another problem, which means that those who insure have less incentive to reduce their exposure to risk.

Homemade insurance like options or future contracts might work better in some cases.

**Forward and Futures Contracts:** Futures, forwards, swaps, and options are ideal hedging tools. These are known as *derivatives*, because their value is derived from the value of an underlying asset. A forward contract is simply a contract for a transaction which will take place at some future point in time but for which the price is fixed now. Futures contracts are exchange traded standardized forward contracts. A high degree of liquidity exists in futures markets because futures contracts are standardized and mature on a limited number of specified dates each year. Forward contracts, on the other hand, are customized individual contracts entered into between the two parties. A financial manager desirous of hedging his raw material prices could negotiate a forward contract with the firm's main raw material supplier. Most forward contracts arise from dealings in foreign exchange currency markets. A financial manager may manufacture a forward loan by borrowing short-term and lending long-term. Such homemade forward contracts may occur either in foreign exchange or in loans. Forward and future contracts are not to be confused with options; a party entering into a forward contract promises to buy or sell the specified commodity or currency at the specified price. there is no option to back out.

Futures contracts are available for a wide range of commodities, financial instruments, and foreign currencies. The commodities traded in the futures markets include grains and oilseed, livestock and meat, food and fiber, and metals and petroleum. Financial instruments traded include various stock market indexes and a number of interest related instruments. Most major foreign currencies have exchange traded futures contracts.

Futures contracts allow one to hedge the risk of a present or expected position by buying (the long hedge) or selling (the short hedge) the contract for future delivery. A farmer expecting to have wheat or corn in a few months can lock in a price by going short or selling futures contract for delivery close to the date of his expected crop. Similarly, a miller could lock in a price for his expected future purchase by buying futures contracts. Excess demand for or supply of futures contracts is absorbed by speculators. Futures contracts are important for the management of risk relating to prices of physical commodities, stock prices, and interest rates. By hedging with futures, financial managers can lock in fix prices on commodities or financial instruments that will not be available until some time in the future.

The Mechanics of Futures Trading: When financial futures are bought (or sold), one does not pay (or receive) the price of the contract till the date of delivery. The transactions require the buyer or seller to make a margin deposit in cash or securities. This serves as collateral for performance of the contract. Each day futures contracts are marked to market to determine profits or losses. Any gain that accrues on the re-pricing of the futures contracts is not available to the parties to the contract, till the contract is settled.

Setting up a futures hedge is similar to any other hedge. First, you identify your risk exposure. For example, let us say that you are expected to need cotton fiber in November. You can find the futures contracts with the closest relationship to cotton and establish a long position in the futures market. In this case, you can actually use cotton fiber futures and buy them for delivery in November.

Here are some important points about futures and futures hedging:

- Futures contracts are standardized as to the date, quantity, and specifications of the underlying asset.
- They are traded through organized exchanges and you are required to keep margin deposits as security for your position.
- Speculators are essential to futures contract markets because they take up the imbalances between futures contract supply and future contract demand.
- Spot prices are prices for immediate delivery of the contracts.
- As the delivery date for futures contracts approaches, the contracts become more and more like spot contracts and the prices approach the spot price.

**Spot and Futures Prices:** The price of a futures contract will have a definite relationship with the spot price of the same financial instrument or the commodity. Financial futures, for example, differ from buying exactly the same item in the spot market in that the buyer does not pay for the security at the time the order is placed and can earn interest during the interim. The buyer also does not receive dividends or interest normally paid to the holder of the actual instrument. Thus we get:

$$F_t = S_0(1 + r_f - y)^t$$

Commodity fixtures are more complicated than financial futures. When one is dealing in commodity futures, payment is not made immediately for the entire contract, and interest may be earned. In addition, the purchaser of the contract does not incur any storage fees. The *convenience yield* is forgone, however, when one buys commodity futures because the commodity is not available for immediate use. In other words, the futures contract does not help you use the commodity for any current needs. Thus the relationship between spot and future prices for commodities can be written as:

$$F_t = S_0(1 + r_f - \text{storage costs} - \text{convenience yield})^t$$

Usually the storage costs or convenience yield cannot be observed and the difference of convenience yield and storage costs is written as *net convenience yield.*

Net convenience yield = convenience yield – storage costs.

We can rewrite the above relationship as:

$$F_t = S_0(1 + r_f - \text{net convenience yield})$$

Note that when you write in this form, $r_f$ should equal the interest for the period. Net convenience yield reflects the net amount of convenience yield and storage costs. A commodity in temporary short supply will see its spot price run high indicating high convenience yield. The storage cost is a function of the nature of the commodity and its value to weight ratio. If storage costs are

high relative to convenience yield, the net convenience yield will be negative. Note that the above relationship will not apply for "commodities" which cannot be stored. For these, there may not be a clear relationship between spot and future prices. Futures contracts on electricity are good examples.

**Homemade Forward Contracts:** A financial manager can construct a forward contract, which is the equivalent of a homemade futures contract. The forward rate agreement (FRA) is one way to customize futures contracts. Most forward contracts arise from dealings in foreign exchange currency markets. A financial manager may manufacture a forward loan by borrowing short-term and lending long-term. Such homemade forward contracts may occur either in foreign exchange or in loans. For example, we can get a 1-year forward interest rate by borrowing for 2 years and lending (depositing the money) for one year. The relationship can be expressed as:

$$1 \text{ year forward interest rate} = \frac{(1 + 2 \text{ year borrowing rate})^2}{1 + 1 \text{ year lending rate}} - 1$$

**Swaps:** A swap is created when two companies enter into an agreement to exchange cash flows set by fixed or variable interest rates. In effect the two parties are lending each equivalent loans, but on different basis for interest rates. The different bases for interest rate may be fixed rate and floating rate or just interest rates in different currencies. The rationale for swap follows from the fact each of the two parties to a swap may have "competitive advantage" in one of the markets, but would want to borrow in the market other than the one they have advantage in. For example, an American company may be interested in borrowing Japanese yen, while a Japanese firm may be interested in US dollar loans. Each firm is likely to be better known in its home market. An optimal arrangement can be worked out whereby each firm issues debt in its home country, receive that currency, and then swap it for the other country's currency. This is a currency swap. Swaps also exist on loans in which a fixed interest-rate loan is exchanged for a floating-rate loan, or involve two floating-rate loans tied to different base rates. In practice swaps are arranged through a third-party dealer and would involve some transaction costs. Note that a mutually beneficial swap can be arranged whenever there is a relative advantage to one party in one market and for the other party in the second market.

Credit Derivatives: Credit derivatives allow lenders to transfer default risk to other parties. These enable banks and other financial institutions to reduce their risk in specific loan markets. Many credit derivatives are *default swaps*, where one party pays the other if there is default on a loan or a group of loans. This is similar to buying default insurance.

**How to Hedge:** There are a number of general principles involved in hedging. The most important one is how to think about the relationship between the risks you want to reduce and the kinds of contracts available to hedge it with. It is likely that no contract will give a perfect hedge: There will generally be residual (or basis) risk between the risk and the hedge. Hedging commodity prices, exchange rates, interest rates, and stock market levels are all very similar. Many risks change continuously through time, so their hedges have to be adjusted as a dynamic hedge quite frequently through time.

Here are the steps involved in setting up a hedge:

- Find the relationship between the commodity or asset position (say, A) you want hedged and the futures contract (B). You can study the historic relationship between the two and it may be expressed as follows:

  Expected change in value of A = a + δ (change in value of B)

- Delta (δ) measures the sensitivity of A to changes in the value of B.

- It is called the *hedge ratio*. It is the number of units of B, which should be purchased to hedge a position in each unit of A.

- Duration hedging is very similar. Duration measures sensitivity to a parallel shift in interest rates (chapter 23).

Options, deltas and betas: We learned about options and option deltas in chapter 20. Options can be used to hedge positions in stocks or commodities. The option delta is similar to the delta in the hedging relationship described above. Note that δ is the number of shares equivalent to position in each option. For each option you hold, you will get a perfect hedge if you sell δ shares. If you want to hedge a position in one share you will have to sell 1/δ options. Option deltas change as the stock prices change, so that in order to remain hedged one will have to change the position continuously. Betas of stock portfolios also express similar relationship. If you have a portfolio with a beta of 1, you can hedge by selling index futures contracts of equal amount.

**The Role and Use of Derivatives:** Derivatives provide an extremely flexible set of instruments, which enable many kinds of risks to be hedged. They can also be used for speculative purposes, and this has brought some companies into serious trouble and caused questions to be asked about the derivatives markets themselves. The chapter provides some commonsense guidelines for making sure you only use derivatives in a way, which helps your company. Senior management of companies should be aware of the risks they are taking and ensure that control systems exist to prevent anyone from taking excessive risk. Companies should only venture into areas where they have comparative advantage. In other words, know what you are getting into and do not go beyond your depth of understanding.

**WORKED EXAMPLES**

1. Jean Grahn has $200,000 of Tixar Corp. stock and that she wants your help in determining how much of the Standard & Poor's 500 Index (S&P 500) she should sell in order to hedge the market-related risk to which she is exposed. The historical relation between the stock's change in price and the change in price of the market index is

Monthly change in value of Tixar shares = a + δ (monthly changes in market index)
= 0.05 + 1.5(monthly changes in market index)

SOLUTION

To hedge her position, Jean must sell futures contracts worth \$300,0000 (1.5 x \$200,000). This hedges position.

2. The S&P 500 stock index 2-month futures are trading at 1,125.50 and the spot S&P 500 index is at 1,122.73. The 2-month interest rate (annualized) is 4.3 percent, and the average annual dividend yield on the index is 2.80 percent. Are these rates consistent?

SOLUTION

$F_t = S_0(1 + r_f - y)^t$

$S_0(1 + r_f - y)^t = 1122.73\ (1+0.043\ -0.028)^{(2/12)} = 1125.52$

The two values are nearly same. There is no arbitrage opportunity.

3. Mercury Motor Company is able to borrow at an annual rate 8 percent for 2 years, using its automobile loans as collateral. The loans are made from Mercury Acceptance Corporation, a wholly owned subsidiary. It estimates that its overall annual return from car loans is 10 percent. If the average automobile loan is 3 years in length, what forward interest rate is implied by this homemade forward contract?

SOLUTION

$$\text{Forward interest rate} = \frac{(1+3\text{ year rate})^3}{(1+2\text{ year rate})^2} - 1 = \frac{1.10^3}{1.08^2} - 1$$

$$= 14.11 \text{ percent}$$

4. Grey Mare Company (GMC) plans to set up a machine tools plant in Italy and needs 20 million Euros. It finds it can get better financing terms if it borrows in the United States than in any other country. It issues \$18 million 5-year, 10 percent notes in the U.S. capital markets. Simultaneously, it enters into a swap agreement with its Italian bank, for an equivalent Euro loan carrying 12 percent interest rate. The details of the agreement are: (1) GMC is to swap its dollar liabilities into Euro (2) the bank pays GMC sufficient dollars to service the debt; and (3) GMC agrees to make annual payments in Euro to cover the Euro loan. What is the result of this currency swap? Assume an exchange rate of \$0.90/Euro.

SOLUTION
20 million Euros = 20 x 0.9 million dollars = \$18 million

(cash flows in millions)

| | Year 0 | | Years l - 4 | | Year 5 | |
|---|---|---|---|---|---|---|
| | $ | Euro | $ | Euro | $ | Euro |
| Issue dollar notes | +18 | 0 | -1.8 | 0 | -19.8 | 0 |
| Swap $s for Euros | -18 | 20.0 | +1.8 | -2.4 | +19.8 | -22.4 |
| Net cash flow | 0 | 20.0 | 0 | -2.4 | 0 | -22.4 |

GMC has effectively converted its 10 percent dollar loan into a 12 percent Euro loan.

5. Sheen Parts Corp. (SPC), a Dallas based auto parts manufacturer is planning an expansion into Germany and wants to borrow in Euro. Zeit Zimmer Gmbh (ZZG), a German car manufacturer plans to move into the US market and wants to borrow in US dollars. SPC can get US dollar loans at 9% and Euro loans at 11 percent. ZZG can obtain US dollar loans at 9 percent and Euro loans at 8 percent. Design a swap such that SPC gets 30 percent of the total cost savings and ZZG gets 70 percent of the total cost savings.

SOLUTION:

First let us find the total cost saving likely to result from a swap between the two. Note that SPC has comparative advantage in the US market and, ZZG has advantage in the German market. Without the swap, SPC will borrow in Germany at a cost of 11 percent and ZZG will borrow in the US at 9 percent. The total cost will be 11 + 9 = 20 percent. If each party borrows in the market of their relative advantage, the total cost in annual interest rates will be: SPC's dollar loans at 9 percent + ZZG's Euro loans at 8 percent = 17 percent. Thus there is a cost saving of 3 percent. If ZZG is to get 70 percent of this, the swap should lower its borrowing cost to: 9 - 2.1 = 6.9 percent. Similarly SPC should lower its cost by 0.9 percent to: 11 - 0.9 = 10.1 percent. The details of the swap can be designed in many different ways, but all of which require that SPC borrows in the US and ZZG borrows in Germany and each swap the flows to the other. You can be set up the details as to the exact interest flows in many ways. Here is one, which will satisfy the condition of the 70/30 split of the savings:

SPC borrows US dollars at 9 percent and charges ZZG 9 percent.
ZZG borrows Euros at 8 percent and charges SPC 10.1 percent.

Net cost to SPC = 9% - 9% + 10.1% = 10.1%
Net cost to ZZG = 8% - 10.1% + 9% = 6.9%

Note that transaction costs and the risk of counter party default are ignored.

6. Jamie Milan owns $100,000 in a mutual fund, which has a very high correlation to the S & P 500 index and a beta close to 1. Jamie wants to sell his fund now, but was advised by his tax consultant to wait for another six to take advantage lower rates next year. Suggest a hedging strategy for Jamie.

SOLUTION

Since the correlation with S & P 500 is very high and the fund's beta is close to 1, Jamie can effectively hedge his position by selling S &P 500 Index futures contracts worth $100,000.

## SUMMARY

Managers and businesses are in the business of taking risks. However, they are better off taking the risks they are best equipped to handle and where they have expertise and skill. Hedging enables businesses to reduce the risks, which are not related to their areas of expertise or are unrewarding. Managers can choose the risk they want to reduce or hedge. They can use either insurance or hedging tools available in the market.

The hedge is established by buying futures, forwards, swaps, or even options contracts. The use of all these is explained in the chapter. Because hedging mitigates the risk of individual assets, the firm's total risk is also reduced. Hedging tactics are important because they allow financial managers to concentrate their energies on decisions whose risks are not easily hedged or diversified away.

## LIST OF TERMS

Adverse selection
Arbitrageurs
Basis risk
Convenience yield
Counterparty
Delta
Derivative instruments
Forward contract
Forward rate agreement (FRA)
Futures contract
Hedge
Hedge ratio
Immunized
Jump risk
Long hedge
Marked to market
Moral hazard
Net convenience yield
Short hedge
Spot price
Storage costs
Swap

## EXERCISES

### Fill-in Questions

1. A(n) _____ offsets risks by trading assets or liabilities for other assets.

2. _____ measures the sensitivity of one asset's value to changes in the value of another.

3. Futures, forwards, swaps, and options are called _____ instruments, because their value depends on the value of other assets.

4. The problem that insurance tends to be bought by those most at risk is called the problem of _____.

5. The problem that once you have insurance you have less incentive to reduce the risks you take is called _____.

6. _____ contracts are contracts traded on organized exchanges to buy or sell commodities or securities in the future on terms fixed today.

7. Futures contracts are _____ daily to determine profits and losses.

8. The delta of the relationship between the risk and the hedging instrument establishes the _____ for the hedge.

9. When a hedge has been established, the position is said to have been _____ against that particular source of risk.

10. When the prices of two commodities are not likely to move exactly together, a perfect hedge is not possible. The remaining risk is called _____ and the hedge ratio is greater than, less than) _____ one.

11. Selling futures contracts is a(n) _____.

12. Buying futures contracts is a(n) _____.

13. Today's price of a commodity is called the _____.

14. The discounted futures price of a commodity equals the spot price plus the present value of_____ and minus the present value of the _____.

15. The difference between the convenience yield and the storage cost is called the _____.

16. Financial managers who wish to trade in futures contracts, which are non-standardized or which mature at dates other than those traded in the futures markets must use _____.

17. A(n) _____ is an agreement with a bank in which an interest rate today is locked in for a loan to be delivered from the bank at some future date.

18. If significant price differentials exist between forward and futures markets, _____ will buy and sell contracts so that such discrepancies will be eliminated.

19. Firms that issue debt in the country in which they are well known, receive that currency, and then exchange it for another country's currency are said to have engaged in a currency _____.

20. The persons or companies taking the two sides of a swap transaction are referred to as _____

21. Many insurance risks are _____ and are probably the type of risk that would like to have covered by insurance rather than by hedging.

**Problems**

1. Chester Malloy is your friend and he tells you how he shorted $3 million of Myra Images Corp. stocks. He wants your help in determining how much of the Standard & Poor's 500 Index (S&P 500) he should buy in order to hedge the market-related risk to which he is exposed. The historical relation between the stock's change in price and the change in price of the market index is

   Monthly change in value of Myra Images = $a + \delta$(monthly changes in market index)
   $= 0.35 + 2.2$(monthly changes in market index)

2. ABC Corp. is able to borrow at 10 percent for 1 year, using its credit card receivables as collateral. It estimates that its overall return from the credit card loans is 12 percent. If the average credit card loan is of 2 years maturity, what forward interest rate is implied by this homemade forward contract?

3. Mayo Corp. plans to modernize its German manufacturing facility. The estimated financing needs are 30 million Euros. It finds it can get better financing terms if it issues $27 million of 6-year, 8 percent notes in the U.S. capital markets. Simultaneously, it enters into an agreement with its German bank for an equivalent Euro loan swap. The Euro loan carries 10 percent interest rate. Assume an exchange rate of $0.90/Euro. Demonstrate the "numbers" of this currency swap.

4. Borza Corp. and Mettle, Inc. can borrow fixed or floating rate loans as below:

| | Borza Corp. | Mettle, Inc. |
|---|---|---|
| Fixed rate loans | 8% | 10.0 % |
| Floating rate loans | T-bill + 1% | T-bill +2% |

Borza wants to borrow at floating rate and Mettle wants to get a fixed rate loan. Can you design a swap, which will lower borrowing costs for both companies? Assume that the cost savings from the swap are shared equally.

5. Recent quotations from the Coffee, Sugar and Cocoa Exchange show the following:

| | Spot Price | 5-month futures price |
|---|---|---|
| Coffee | $0.52/lb | $0.59/lb |
| Sugar | $0.071/lb | $0.053 |
| Cocoa | $1,790/ton | $1,492/ton |

The short-term interest rate is 4.5 percent. Estimate the net convenience yield for each commodity. Comment on the net convenience yield numbers you get. Does it look like there is a shortage in any of the commodities?

**Essay Questions**

1. Discuss the statement. " Managers are paid to take risk.".

2. Describe the difference between adverse selection and moral hazard, and explain why they cause problems for insurance companies.

3. Describe the process of hedging through financial futures, giving examples.

4. Demonstrate how forward contracts may be constructed to suit a particular need you can think of.

5. Discuss the statement. "Derivatives have improved the hedging opportunities for managers."

6. Your company is a one of the largest packaged food producer in the world and consumes large quantities of corn, wheat, pork bellies, etc. Devise a hedging strategy for the firm, explaining why you might want to hedge the risk in your primary supplies.

**ANSWERS TO EXERCISES**

**Fill-in Questions**

1. Hedge
2. Delta
3. Derivative
4. Adverse selection
5. Moral hazard
6. Futures
7. Marked to market
8. Hedge ratio
9. Immunized
10. Basis risk; less than
11. Short hedge
12. Long hedge
13. Spot price
14. Storage costs; convenience yield
15. Net convenience yield
16. Forward contract
17. Forward rate agreement (FRA)
18. Arbitrageurs
19. Swap
20. Counterparties
21. Jump risk.

**Problems**

1. To hedge the short sale, Chester must set aside \$6,6,00,000 (2.2 x\$3,000,000).

2. Forward interest rate = $[(1.12)^2/1.10] - 1 = 14.04$ percent

3.

| | Cash flows in millions | | | | | |
|---|---|---|---|---|---|---|
| | Year 0 | | Years 1 - 5 | | Year 6 | |
| | \$ | Euro | \$ | Euro | \$ | Euro |
| Issue dollar notes | +27.0 | 0 | -2.16 | 0 | -29.16 | 0 |
| Swap for Euros | -27.0 | 30.0 | +2.16 | -3.00 | +29.16 | -33.00 |
| Net cash flow | 0 | 30.0 | 0 | -3.00 | 0 | -33.00 |

The swap has resulted in a Euro loan carrying 10 percent interest.

4. Borza's comparative advantage is in the fixed rate market as it can borrow at 2 percent lower than Mettle. Mettle has comparative advantage in the floating rate market as it has to pay only 1 percent higher than the rate paid by Borza. Note that Borza has a lower rate or absolute advantage compared to Mettle in both markets. Each party can benefit by borrowing in the market of their comparative advantage and swapping the loans to get their preferred type of loan. The total cost of each company borrowing directly in their preferred market: T-bill+1% + 10% = T-bill + 11 %. If each borrows in the market of comparative advantage, the total cost will be: 8% + T-bill + 2% = T-bill + 10 %. Thus, the swap should give a total saving of 1 percent. If the saving is shared equally, Borza should end up with a floating rate loan of T-bill + 0.5% and Mettle should have a fixed rate loan of 9.5%. This can be accomplished as follows:

   Borza borrows fixed rate at 8% and passes it on to Mettle at 9.5%.
   Mettle borrows floating rate at T-bill+2 % and passes it on to Borza at the same rate.
   Borza's effective cost = 8% - 9.5% + T-bill+2% = T-bill+0.5%.
   Mettle's effective cost = T-bill+2 - (T-bill+2) + 9.5% = 9.5%.

5. $F_t = S_0(1 + r_f -$ net convenience yield)
   Net convenience yield $= S_0(1 + r_f)^t - F_t$

   $(1 + r_f)^t = (1.0045)^{5/12} = 1.0185$

| Commodity | Spot price | Futures price | $S_0(1 + r_f)^t$ | Net convenience yield |
|---|---|---|---|---|
| Coffee | \$0.52/lb | \$0.59/lb | \$0.5296 | -0.064 cents/lb |
| Sugar | 7.1 cents/lb | 5.3 cents/lb | 7.2314 cents/lb | 1.9314 cents/lb |
| Cocoa | \$1,790/ton | \$1,492/ton | \$1823.12/ton | \$331.12 |

For coffee, it appears that storage costs dominate the net convenience yield. For both sugar and cocoa, the net convenience yield is fairly high compared to the spot price, perhaps indicating a temporary shortage.

# 28

# Managing International Risks

## INTRODUCTION

This chapter covers management of risks brought on by international exposure of one kind or another. Exposure to international risks has become very common on account of the expanding global trade and investment. A company with investments and real operations overseas obviously faces significant international risks. Even those companies, which operate within their home countries, are not immune from international risk, as they would have customers, suppliers, and/or competitors from abroad. In other words, there are very few purely "domestic" operations, which will not be affected by international risks such as changes in exchange rates, global market conditions for major commodities, and significant geopolitical events.

International risk arises from one of three broad sources: exchange rate changes, interest rate differences and political risk. An understanding of the exchange markets is the first step in understanding exchange risk. The chapter begins with a description of the foreign exchange markets. It then goes on to explain a set of basic relationships covering exchange rates, interest rates and inflation across countries. This is followed by sections on hedging currency risk, international investments and political risk.

## KEY CONEPTS IN THE CHAPTER

**Foreign Exchange Markets:** The foreign exchange market is global and has no one central trading place. Trading takes place all over the world, though most of the trading is done in centers like New York, London, and Frankfurt. The daily volume of currency transactions in these markets exceeds over 1 trillion dollars. International banks and some large multinational corporations are the major players in currency markets. The transactions can be spot or forward. Spot transactions are for immediate delivery and forward transactions are completed at future points in time at prices agreed upon now.

An e*xchange rate* is the price of one currency in terms of another. A *direct quote* (for Americans) is the dollar price of 1 unit of the foreign currency. For example $1.335/Euro and $1.95/British pound are direct quotes. An *indirect quote* is given as units of foreign currency needed to buy one dollar (e.g. Yen 104.5/$). Indirect quotes are commonly used for most currencies. The British pound sterling and the Euro are the exceptions and are quoted in direct terms. There is also an organized futures market for currencies. Futures are (as we saw in chapter 27) standardized forward contracts and are available for most major currencies. You can also buy options on the futures contracts. Banks sell custom designed option contracts on currencies. There are also more complicated contracts combining features of a forward contract and options.

The forward rate for currency reflects the market's expectation about the change in the currency's expected future spot rate. A currency is said to have a *forward premium* (*discount*) if the forward rate in direct terms is higher (lower) compared to the spot rate. Normally, the premium is computed as an annualized percentage.

**Some Basic Relationships:** If individuals are not worried about risk and there are no barriers to international trade, exchange rates would be governed by four fundamental relationships. These relationships cover the current spot and forward exchange rates, the interest rates in the two countries, the inflation rates in the two countries, and the expected future spot rate. The four relationships are interdependent. The difference in interest rates between two currencies is equal to the difference in the expected inflation rates, which in turn is equal to the expected change in spot rate. This change in spot rate is equal to the difference between the forward and spot rates, which in turn is equal to the difference in interest rates between two different currencies. These relationships are based on the economic argument that the real rate of return on invested capital among all countries tends to equilibrate even though nominal interest rates may differ on account of inflation.

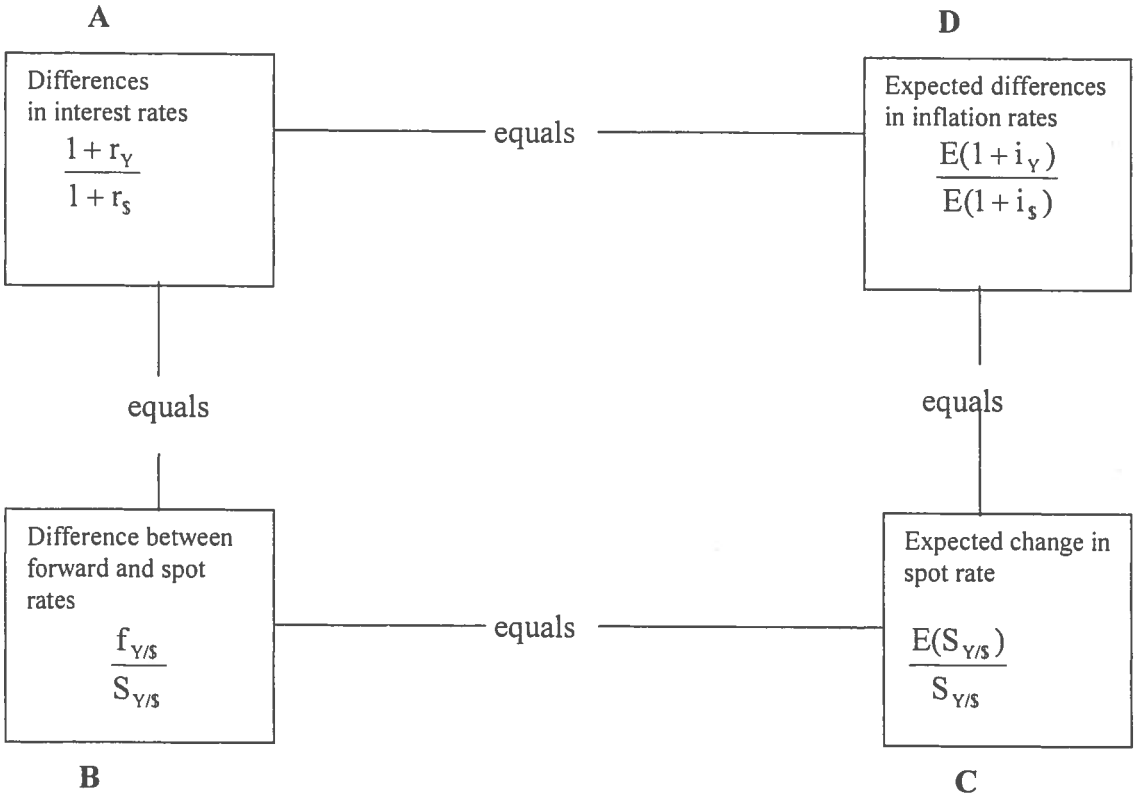


Figure 1 – Four basic Relationships for the Yen and the Dollar

Note that the exchange rates are expressed in indirect terms of Yens/$. Each of the above relationships is reviewed below.

Interest rates and exchange rates (boxes A and B): This is known as the *interest-rate parity.* The difference between interest rates must equal the differential between the forward and spot exchange rates. This relationship seems to hold pretty well when taxes and government regulations are absent. This is the case in international markets (Eurocurrency markets). If the relationship does not hold, one can make money by borrowing in one currency, lending in the other, and covering the exchange rate risk with forward contracts.

The forward premium and changes in spot rates (boxes B and C): This relationship (the *expectations theory*) implies that the expected change in spot rate should equal the current forward premium (or discount). This theory ignores risk. On average the forward rate can be expected to equal the future spot rate. The relationship may not hold exactly and the forward price may be an over or underestimate.

Changes in the exchange rate and inflation rates (boxes C and D): If goods flow freely across borders, then the prices should roughly be equal across countries. This is often called the p*urchasing power parity* (PPP) implying that similar goods should be priced roughly the same in each country. This also means that the differences in inflation rates get reflected in exchange rates. That is if the inflation rate is 3 percent in the US and 2 percent in Japan, the yen will appreciate by about 1 percent or the number of yens required to buy a dollar will fall by about 1 percent. The PPP holds broadly in the long run, but short run deviations are not uncommon. The estimated difference in relative inflation rates between two countries can be seen as a rough estimate of the expected change in the spot exchange rate.

Interest rates and inflation rates (boxes D and A): Capital tends to flow to its highest and best use and in equilibrium expected real return on capital should be the same in different countries. Thus the money rate of interest will reflect expected inflation and differences in money rates should equal the expected differences in inflation rates. This is known as the international Fisher effect.

The four relationships in practice:

Interest-rate parity: Works well in international markets, but not so well in domestic markets because of government regulations and taxes.

The expectation theory of forward rates: On average the forward rate equals the future spot rate; however it often overshoots one way or the other. Forward rate is seen as a better predictor than exchange forecasting services.

Purchasing power parity: Generally holds well over the long term. It is also seen that where there are large differences in inflation between countries (example - Bolivia and the US in the eighties), the adjustment is more rapid.

Real interest rates across countries: High inflation countries have higher interest rates and real rates seem to converge, though in the short-term a disparity in real rates might exist especially

where government regulations and taxes are significant factors. Part of the problem in testing this theory is that we cannot observe expected inflation rates and expected real rates.

**Currency Risk:** Most companies engage in some form of exchange risk hedging. Exchange risk is often classified as either *transaction exposure* or *economic exposure*. Transaction exposure is the risk of unfavorable exchange rate movements affecting known commitments in foreign currency. For example, a company, which is expecting a payment in a foreign currency from an export transaction, is facing a transaction exposure. Transaction exposure can be easily hedged through different means as discussed below. Economic exposure is refers to the overall impact on the business from changes in exchange rates. This is harder to quantify and managing this risk should be part of the firm's overall global business strategy.

Transaction exposure can be hedged using futures or forward contracts. Hedging can also be done using options, which protect against adverse currency movements without affecting any possible gains form favorable movement of exchange rate. In theory one can also hedge by lending or borrowing in the foreign currency depending on the direction of the exposure (borrow if you are expecting a foreign currency cash flow in future; lend if you have to pay in foreign currency at a future date.) If the interest rate parity holds, hedging by forward/futures contracts or through lending/borrowing should give essentially the same results.

The main advantage of hedging transaction exposure is that the firm is free to concentrate on the main business. Hedging can also be done at a relatively low cost. Foreign exchange markets are reasonably efficient in the major currencies. This means that the cost of hedging is likely to be low. Remember that cost of hedging is not the difference between today's spot rate and forward rate, but the expected spot rate and the forward rate.

**International Investment Decisions:** Overseas investments are evaluated by discounting estimated cash flows at the opportunity cost of capital with adjustments for subsidized financing or other effects. There are two ways to calculate net present value. One converts the foreign currency cash flows into home currency cash flows. These cash flows are discounted using the home country opportunity cost of capital to get the project NPV in the home currency. This method requires a forecast of foreign exchange rates. The other method discounts the foreign currency cash flows at the foreign currency cost of capital to obtain the project NPV in the foreign currency. This is then converted into the home currency using the spot exchange rate. The latter method implicitly assumes that the currency flows are hedged. The two approaches to evaluating foreign projects are summarized below.

| | Approach 1 | Approach 2 |
|---|---|---|
| Step 1 | Estimate cash flows in foreign currency. | Estimate cash flows in foreign currency. |
| Step 2 | Convert to home currency using forecasted exchange rates. | Calculate the net present value using the foreign currency discount rate. |

| | | |
|---|---|---|
| Step 3 | Calculate net present value using the home country discount rate | Convert the NPV to home currency using the current spot rate |

Approach 1 requires exchange rates forecast, while approach 2 does not. However, approach 2 requires computation of opportunity cost for the project in the foreign currency. This approach ignores exchange rate risk. The two approaches should result in the same NPV value. If they do not, it would mean you have used an exchange rate forecast different from that given by the market. The project should be justified based on its cash flows and not on any exploitation of presumed market inefficiency.

**The Cost of Capital for Foreign Investment:** The cost of capital for foreign projects was discussed in chapter 9. The basic approach involves estimation of beta for the foreign project relative to the company's *home market index* and then the calculation of the home currency required rate of return. This rate of return can then be converted into the foreign required rate of return using the following relationship:

$$\frac{1 + \text{home currency return}}{1 + \text{home currency interest rate}} = \frac{1 + \text{foreign currency return}}{1 + \text{foreign currency interest rate}}$$

Remember that diversification is valuable and international diversification may be even more valuable. In general, it is wiser to adjust estimated cash flows for foreign risks than to adjust the discount rate.

**Political Risk:** In a general sense, political risk is not confined to foreign investments. Businesses always face the risk of unanticipated government action, which affect their business adversely. The important difference about foreign political risk is that the risk arises from the fact that your company is a foreign company in that country and may be treated differently because it is a foreign company. The extreme case of political risk is the risk of expropriation. If foreign governments change the rules after you have made your investments, your business profitability gets affected. The key to "managing" political risk is understanding the nature of the risk and then structuring the business, its operations and financing in a way that the probability of adverse foreign government action is reduced. If any adverse action does take place, the effect on the business value should be minimized.

## WORKED EXAMPLES

1. Given below are some recent quotes:

| | Spot Rates | 3- month forward rate |
|---|---|---|
| Japanese Yen | Y104.5/$ | 104.00 |
| British Pound | $1.950/pound | 1.9401 |
| Euro | $1.335/Euro | 1.3288 |

Calculate the forward premium (discount) for each of the currencies.

SOLUTION

The forward premium (discount) for each currency can be calculated as follows:

$$\text{Forward premium (discount)} = \frac{\text{spot rate - forward rate}}{\text{forward rate}} \text{ x } \frac{12}{\text{months to expiration}}$$

Please note that this is the formula used for indirect quotes. For direct quotes, the formula is modified as below:

$$\text{Forward premium (discount)} = \frac{\text{forward rate - spot rates}}{\text{spot rate}} \text{ x } \frac{12}{\text{months to expiration}}$$

The premium is always reported as an annualized number.

$$\text{Premium for Japanese yen} = \frac{104.5 - 104.00}{104.00} x4 = 1.92 \text{ percent}$$

$$\text{Discount for British pound} = \frac{\text{forward rate - spot rate}}{\text{spot rate}} \text{x4} = \frac{1.9401 - 1.950}{1.950} \text{x4} = \text{ -2.03 percent}$$

$$\text{Discount for Euro} = \frac{1.3288 - 1.335}{1.335} \text{x4} = \text{-1.86 percent}$$

Note that the quotes for the British pound and the Euro are in direct terms and the formula was reversed to reflect that.

2. Use the spot exchange rates given in problem 1 and check if the interest rate parity holds or not given the following 3 month interest rates:

| | |
|---|---|
| US dollar interest rate | 2.24 percent |
| Japan | 0.40 percent |
| Britain | 4.20 percent |
| Germany (Euro) | 4.10 percent |

SOLUTION

According to interest rate parity, the relationship among the spot, forward and interest rates can be written as:

$$\frac{\text{forward rate}}{\text{spot rate}} = \frac{1 + \text{foreign interest rate}}{1 + \text{dollar interest rate}}$$

We can write the foreign interest rate = $\frac{\text{forward rate x (1 + dollar interest rate)}}{\text{spot rate}} - 1$

This is the formula for indirect quotes. For direct quotes, the formula would be:

$$\frac{\text{spot rate x (1 + dollar interest rate)}}{\text{forward rate}} - 1$$

Also, note that the interest rate should be for the period of the forward contract. So the dollar rate should be: 2.24/4 = 0.56 percent

Japanese interest rate = [(104 x 1.0056)/104.5] – 1 = 0.08 percent/3 months
= 0.32 percent (annual)

The British interest rate = [(1.95x1.0056)/1.9401] – 1 = 1.07 percent/3 months
= 4.28 percent (annual)

The Euro interest rate = [(1.335x1.0056)/1.3288] – 1 =1.03 percent/3 months
= 4.12 percent (annual)

None of the interest rates reported exactly matches the ones calculated by the interest rate parity, but are fairly close and it is unlikely that there are big profit opportunities.

3. The expected annual inflation in Mexico is 5 percent. The expected inflation for the US is 1.5 percent. If the spot rate for the peso is 9.91 pesos/$, estimate the expected 1-year future spot rate.

SOLUTION

$$\text{Expected spot rate} = \frac{(1 + \text{inflation rate for Mexico}) \text{ x } (1 + \text{spot rate})}{(1 + \text{inflation rate for US})} = \frac{1.05x9.91}{1.015}$$

= 10.252 pesos

4. Dos Amigos Brewery (DAB) exports Mexican beer to the United States. They expect to receive a payment of $875,000 in about 3 month's time from their wholesaler in Texas. The spot and forward rates for the peso are 9.91 pesos/$ and 10.00 pesos/$. DAB has banking relationship with a Houston bank and the bank is willing to lend money to DAB at the US prime rate of 5 percent. DAB's cost of funds in Mexico is 8 percent. Suggest two ways of hedging DAB's dollar exposure. Compare the cash flows resulting from each hedging approach.

SOUTION

DAB can hedge by either: i) sell dollar forward or ii) borrow dollars from its Houston bank and convert the dollars at the spot rate and pay back the bank using its dollar cash receipts 3 months from now. The cash flows of the two approaches are shown below:

Hedging with forward contract:

DAB sells $875,000 forward at 10 pesos/$. Cash flow in 3 months = 875,000 x 10
= 8,750,000 pesos

Present value of the cash flow (annual cost of 8%, quarterly cost = 2%) = 8,750,000/1.02
= 8,578,431 pesos

Hedging through bank loan

DAB borrows the present value of $875,000 to be received in 3 months. The loan amount is converted into pesos now using the spot rate. The loan is paid off by the dollars received in 3 months. First, calculate the loan amount. Annual interest rate of 5 percent converts to 1.25 percent per 3 months.

Loan amount = $875,000/1.0125 = $864,198
Peso cash flow = 864,198 x 9.91 = 8,564,202 pesos

DAB is better off with the forward contract hedging. Its loan rate in the US is too high relative to its cost of funds in Mexico. There appears to be a deviation from the interest rate parity.

6. Barton Restaurants, a large US hamburger chain, is planning to open a number of restaurants in Gardinia. The initial investment is estimated at 25 million Gardinian kronas. Stacy Appleton, the CFO of Barton is evaluating the project on an expected project life of 5 years. The expected annual cash flows for five years are 7.5 million kronas. Stacy collected following additional information:

Current exchange rate = $1/krona
Current US interest rate = 4.5 percent.
Gardinian interest rate = 6.5 percent
US Opportunity cost of the project = 12 percent

Evaluate the project.

SOLUTION

We can use two approaches to evaluate the project. The first approach involves conversion of all cash flows into US dollar and discounting the cash flows with the US opportunity cost of 12 percent. The second approach discounts the foreign cash flows using the foreign opportunity cost and converting the resultant NPV into dollar NPV using the current spot rate. Approach 1 requires forecast of exchange rates for each of the next five years. Approach 2 requires estimation of the foreign opportunity cost.

Approach 1: We can use the interest rates to forecast the future exchange rates. The exchange rate forecasts and the dollar cash flows from the project are given below:

| Year | Forecasted Exchange rate | Cash flow in $million |
|---|---|---|
| Current | spot rate = $1/kr | 25.000 |
| Year 1 | 1 x 1.045/1.065 = $0.9812/kr | 7.359 |
| Year 2 | 1 x $(1.045/1.065)^2$ = $0.9628 | 7.221 |
| Year 3 | 1 x $(1.045/1.065)^3$ = $0.9447 | 7.085 |
| Year 4 | 1 x $(1.045/1.065)^4$ = $0.9270 | 6.953 |
| Year 5 | 1 x $(1.045/1.065)^5$ = $0.9096 | 6.822 |

Use the cash flow worksheet:
$CF_0 = -25$, $CO_1 = 7.359$, $FO_1 = 1$, $CO_2 = 7.221$, $FO_2 = 1$,
$CO_3 = 7.085$, $FO_3 = 1$, $CO_4 = 6.953$, $FO_4 = 1$, $CO_5 = 6.822$, $FO_5 = 1$
Use NPV worksheet: I = 12 %, NPV = $0.6598 million

Approach 2:

We need to estimate the krona opportunity cost of capital for the project. This can be estimated from the following relationship:

$$\frac{1 + \text{home currency return}}{1 + \text{home currency interest rate}} = \frac{1 + \text{foreign currency return}}{1 + \text{foreign currency interest rate}}$$

$$\text{Krona opportunity cost} = \frac{1.12 \times 1.065}{1.045} - 1 = 14.14\ \%$$

First compute the krona NPV: $CF_0 = -25$, $CO_1 = 7.5$, $FO_1 = 5$; Compute NPV, given I = 14.14%
NPV = kr0.6617 million = $0.6617 million.

(The difference in the NPV values for the two approaches is due to rounding.)

**SUMMARY**

This chapter covered the basics of managing the risks associated with international operations. International operations add three additional elements of risk to a company's business: risk caused by changes in exchange rates, risk caused by different interest rates in different countries and political risk. Financial managers should understand the nature of each of these risks. The nature and complexity of each element of risk will be a function of the type of the business, the size of the firm and the nature of international operations.

Understanding the workings of foreign exchange market is a necessary first step to understanding exchange rate risk. There are four basic economic relationships, which govern the changes in exchange rates. These relationships link the spot and forward exchange rates, the interest rates

and the inflation rates across countries. The relationships ignore investor' risk aversion, transaction costs, taxes and other form of government intervention and other market imperfections. Therefore, the empirical validity of the relationships is less than perfect. However, they are reasonable accounts of the relationships involved and are useful for anyone interested in the direction and magnitude of changes in exchange rates. Financial managers would do well to learn the four basic relationships or parity theories as they are often called.

Businesses are exposed to two types of exchange risk: transaction exposure and economic exposure. Transaction exposure is the exposure given by known or committed transactions is quantifiable and can be, in most cases, fully hedged. The cost of hedging should be seen in terms of expected future spot rates rather than current spot rates. Economic exposure, on the other hand, is the long and medium term impact on the firm's business caused by the changes of exchange rates. This is difficult to quantify and hedge. The best approach to managing economic exposure is to treat it as part of the firm's overall risk and develop strategies to control and minimize the impact of the exposure.

International capital investment decisions are no different from any other investment decision. You accept positive NPV projects. The only complexity is that you have cash flows in a foreign currency and these need to be evaluated using the "foreign discount' rate. Alternately, you can convert the foreign currency cash flows into your home currency cash flows and use the home currency discount rate.

The last part of the chapter discusses political risk. Foreign operations are subject to an extra dimension of political risk because it is possible that a foreign company might be treated differently than a domestic firm in the same business. The key to managing political risk is to understand it fully and then design the business operations and financing structure to reflect and minimize the effect of any adverse political action. The nature and level of political risk is a function of not only the country involved but also the industry and the current economic and political situation in the country.

## LIST OF TERMS

Direct quote
Economic exposure
Eurocurrency market
Expectations theory of exchange rates
Forward market
Indirect quote
Interest rate parity theory
Purchasing power parity
Spot exchange rate
Transaction exposure

## EXERCISES

### Fill-in Questions

1. An exchange rate quotation for the price of a currency for immediate delivery is known as _____.

2. Financial managers who buy and sell currency for future delivery do it in the _____ market for foreign currencies.

3. The relationship between the interest-rate differential and the annual forward premium or discount is known as the _____

4. The _____ theory of exchange rates says that the percentage difference between the forward exchange rates and the spot exchange rates is equal to the expected change in the spot rate.

5. The _____suggests that expected changes in the spot exchange rate is approximated by estimated differences in relative _____ rates.

6. The international market for short-term loans that is virtually free of government regulation is called the _____ market.

7. Most currency quotations are given as _____ quote, and give the number of units of foreign currency needed to buy one United States dollar.

8. The Euro and the British pound are normally quoted using the _____ quote, which gives the number of US dollars needed to buy one unit of foreign currency.

9. The risk from an exchange rate movement on currency receipts/payments already contracted is known as _____.

10. The risk from an exchange rate movement on the value of the entire business is known as _____.

**Problems**

1. Given below are quotes for the Canadian dollar and the Euro. Calculate the forward premium or discount.

| | Spot rate | 6-month Forward rate |
|---|---|---|
| Canadian dollar | $0.7316/C$ | $0.7170/C$ |
| Euro | $1.335/Euro | $0.1.3026/Euro |

Also, compute the C$/E cross rates (spot and forward).

2. The current dollar one-year interest rate is 3 percent. The one-year interest rate in India is 7.5 percent. The spot exchange rate for the Indian rupee is Rs. 44/$. Estimate the likely one-year forward exchange rate for the rupee, assuming interest rate parity.

3. Meyer GmbH is a Munich based sports good manufacturer. They export archery equipment to the US. The company is expecting a payment of $5 million in 3 months. The spot and forward rate for the Euro are $1.335 and $1.3288 respectively. Meyer has an opportunity cost of funds of 6.5 percent in Germany. It can also borrow dollars from its New York bank at the rate of 4.5 percent. Suggest the best hedging approach for Meyer.

4. Sun Motors Corp. (SMC), a Korean auto parts company is planning an investment in India. The initial investment is estimated to cost 560 million Indian rupees. Soyul Kim, the CFO of SMC is evaluating the project on an expected project life of 6 years. The expected annual cash flows for six years are 135 million rupees. Soyul collected the following additional information:

   Current exchange rate = Rs.26/Korean Won
   Current Koran interest rate = 9.5 percent.
   Indian interest rate = 7.5 percent
   Korean Opportunity cost of the project = 15 percent

   Evaluate the project.

## ANSWERS TO EXERCISES

### Fill-in Questions

1. Spot rate
2. Forward
3. Interest-rate parity
4. Expectations theory
5. Purchasing power parity, inflation
6. Eurocurrency
7. Indirect
8. Direct
9. Transaction exposure
10. Economic exposure

### Problems

1. Both quotes are given in the direct quotes format. The forward premium can be calculated using the following formula

$$\text{Forward premium (discount)} = \frac{\text{forward rate - spot rate}}{\text{spot rate}} \times \frac{12}{\text{months to expiration}}$$

$$\text{Forward premium or discount for C\$} = \frac{0.7170 - 0.7316}{0.7316} \times 2 = -3.99 \text{ percent}$$

That is the Canadian dollar is at a discount of 3.99 percent.

$$\text{Forward premium or discount for the Euro} = \frac{1.3026 - 1.335}{1.335} \times 2 = -4.85 \text{ percent}$$

The Euro is at a discount of 4.85 percent.

$$\text{Cross rate C\$/Euro} = \frac{\text{Dollar price of Euro}}{\text{Dollar price of C\$}}$$

Spot C$/Euro = 1.335/0.7316 = C$1.8248/Euro
Forward rate = 1.3026/0.7170 = C$1.8167/Euro

$$\text{Forward premium or discount} = \frac{1.8167 - 1.8248}{1.8248} \times 2 = -0.89 \text{ percent}$$

The Euro is at a discount of 2.45 percent relative to C$.

2. The one-year forward rate for Rupee $= \frac{44 \times 1.075}{1.03} = \text{Rs.}45.92/\$$
3. Meyer can hedge in two ways. See the worked example problem 5.The quarterly German interest rate would be 6.5/4 = 1.625 %, and the corresponding US rate 1.125%.

Hedging through forward contracts: Meyer sells $5,000,000 forward at the rate of $1.3288/Euro. Present value of this can be computed as below:

$$\text{Cash flow from forward hedging} = \frac{5{,}000{,}000}{1.3288} \times \frac{1}{1.01625} = 3{,}702{,}626 \text{ Euros}$$

Hedging through dollar loan: Meyer can borrow the present value of $5,000,000 now and convert the loan amount at the spot rate of $0.88/Euro. The loan will be repaid by the receivable cash flow.
Loan amount = $5,000,000/1.01125 = $4,944,376
Euro cash flow by conversion using spot rate = $4,944,376/1.335 = 3,703,652 Euros

The latter is a slightly better alternative.

4. See worked example 6. We can use the same two approaches to evaluate the project. The first approach involves conversion of all cash flows into Korean wons and discounting the cash flows with the Korean opportunity cost of 15 percent. The second approach discounts the rupee cash flows using the Indian opportunity cost and converting the resultant NPV into Korean won NPV using the current spot rate. Approach 1 requires forecast of rupee exchange rates for each of the next five years. Approach 2 requires estimation of the Indian opportunity cost.

Approach 1: We can use the interest rates to forecast the future exchange rates. The exchange rate forecasts and the Korean won cash flows from the project are given below. Note that the exchange rate is an indirect quote (rupee/won); so the formula used in the worked examples is reversed:

| Year | Forecasted Exchange rate | Cash flow in million Wons |
|---|---|---|
| Current | spot rate = Rs26/won | -21.5385 |
| Year 1 | 26 x 1.075/1.095 = Rs.25.525 | 5.6807 |
| Year 2 | 26 x $(1.075/1.095)^2$ = Rs.25.059 | 5.7864 |
| Year 3 | 26 x $(1.075/1.095)^3$ = Rs.24.601 | 5.8940 |
| Year 4 | 26 x $(1.075/1.095)^4$ = Rs.24.152 | 6.0037 |
| Year 5 | 26 x $(1.075/1.095)^5$ = Rs.23.278 | 6.1154 |
| Year 6 | 26 x $(1.075/1.095)^6$ = Rs.22.853 | 6.2291 |

Use the cash flow worksheet:
$CF_0 = -21.5385$, $CO_1 = 5.6807$, $FO_1 = 1$, $CO_2 = 5.7837$, $FO_2 = 1$, $CO_3 = 5.8940$, $FO_3 = 1$, $CO_4 = 6.0037$, $FO_4 = 1$, $CO_5 = 6.1154$, $FO_5 = 1$, $CO_6 = 6.2291$, $FO_6 = 1$

Use NPV worksheet: I = 15 %, NPV = 0.8181 million wons

Approach 2:

We need to estimate the rupee opportunity cost of capital for the project. This can be estimated from the following relationship:

$$\frac{1 + \text{home currency return}}{1 + \text{home currency interest rate}} = \frac{1 + \text{foreign currency return}}{1 + \text{foreign currency interest rate}}$$

$$\text{Rupee opportunity cost} = \frac{1.15 \times 1.075}{1.095} - 1 = 12.9\ \%$$

First compute the rupee NPV: $CF_0 = -560$, $CO_1 = 145$, $FO_1 = 6$; Compute NPV, given I = 12.9%
NPV = Rs.21.2625 million = 0.8178 million wons.

This is practically the same as Approach 1.