Chapter 21

Interest Rate and Foreign Currency Swaps

In 2002, only 18% of Wal-Mart's outstanding debt had payments that fluctuated with the short-term interest rate. By 2003, it had increased the exposure of its outstanding debt to short-term interest rates to more than 40% by engaging in interest rate swaps. In 2011, Chinese authorities announced that certain banks would be allowed to offer currency swaps to their corporate clients. These corporations can now issue dollar debt and swap into renminbi debt, or vice versa.

This chapter examines interest rate and currency swaps, which are additional instruments for your risk management tool kit. We have previously discussed a number of ways of managing a firm's currency risks using derivative securities, including forward contracts in Chapter 3 and futures and options in Chapter 20. The maturities for these instruments are somewhat limited, whereas the maturities in the swap markets extend to 30 years. We have also noted that exchange rate exposures can be thought of as arising from a general mismatch between assets and liabilities denominated in different currencies. We will see how interest rate swaps allow firms to change the nature of their liabilities for a given currency from fixed to floating interest rates or from floating to fixed interest rates. Currency swaps can be used to change the currency of denomination of a firm's liabilities. Changes such as these can be desirable as the nature of a firm's business changes. Swaps also allow firms to seek out low-cost financing without sacrificing their preferred type of debt.

Section 21.1 introduces the basic ideas associated with swaps and discusses the impressive size of the swap market. Section 21.2 provides a detailed analysis of the cash flows of interest rate swaps, and Section 21.3 provides a detailed analysis of the cash flows of currency swaps.

21.1 Introduction to Swaps

Swaps are agreements between two counterparties to exchange a sequence of cash flows. In the modern swap market, over-the-counter dealers at major banks quote bid–ask spreads at which they are willing to do either side of a swap. The cash flows of interest rate and currency swaps are structured like the cash flows of standard bonds, and the maturities extend from 1 year to 30 years and even more. Many international financial managers now actively use swaps to manage their companies' interest rate and currency risks and for speculative purposes.

The nature of the contract between swap counterparties is usually based on the best practices suggested by the **International Swaps and Derivatives Association (ISDA)**. The ISDA is a trade organization that was chartered in 1985 and now represents more than 800 member institutions from 56 countries. Its members include most of the world's major financial institutions that deal in privately negotiated derivatives, as well as their clients who rely on over-the-counter derivatives to manage the financial market risks inherent in their core economic activities. The most important ISDA document is the ISDA Master Agreement Protocol, which controls the legal aspects of swap cash flows, such as how swaps are closed out in the event of default.

Swaps are effectively agreements between two counterparties to exchange different types of debts. Currency swaps are actually modern counterparts of parallel loans and back-to-back loans, which are still used but are much less important than currency swaps. By examining these early forms of swaps, we can understand why the market began and how it has evolved.

Parallel Loans and Back-to-Back Loans

Parallel loans originated as a means of securing low-cost funding for foreign subsidiaries and to circumvent various government regulations, such as currency controls. Another motivation of these contracts was the desire to avoid taxation on intracompany multinational transactions.

Parallel Loans

Suppose Stars and Stripes Inc., a U.S. corporation, has an Indonesian subsidiary that would like to borrow rupiah, and Java Cava, an Indonesian corporation, has a U.S. subsidiary that would like to borrow dollars. These funding needs could be met in several ways. The most direct way is for each subsidiary to simply borrow the currency it needs. But, if a subsidiary is not well known in the foreign money market, it could be assessed a high default risk premium on the loan, which would make the loan very expensive. A second way for the subsidiaries to raise funds would be for the parent of each subsidiary to borrow the currency the subsidiary needs and to make an intracompany loan. Because parent corporations are usually better credit risks, this is less costly, but the interest payments that the subsidiary makes to the parent may be subject to withholding taxes. This leads to additional expenses of borrowing.

A **parallel loan** avoids these extra expenses. In our example, the Stars and Stripes parent corporation would lend dollars to the Java Cava subsidiary operating in the United States, and the Java Cava parent corporation would simultaneously lend rupiah of equivalent value to the Stars and Stripes subsidiary operating in Indonesia. Because the loans are between entities operating in the same country, problems with the inconvertibility of currencies, exchange controls, and withholding taxes are avoided.

The two loans are separate contractual obligations of the respective parties. This means that interest and principal repayment on one of the parallel loans must be continued even if the other subsidiary defaults on a payment. For example, if the Stars and Stripes subsidiary defaults on its rupiah loan that is owed to the Java Cava parent, the Java Cava subsidiary must continue to pay dollar interest and principal to the Stars and Stripes parent. Parallel loans do not contain a "right of offset," which, in this example, would allow the Java Cava subsidiary to stop payments on the dollar loan if the Stars and Stripes subsidiary defaults on the euro loan.

Back-to-Back Loans

While similar in structure to parallel loans, **back-to-back loans** have two key differences: (1) They involve simultaneous loans between multinational parent corporations (vs. subsidiaries) in two different countries, and (2) they contain the right of offset. In terms of the corporations in our example, a back-to-back loan involves the U.S. headquarters of Stars and Stripes making a dollar loan to the Indonesian headquarters of Java Cava. Simultaneously, the Indonesian headquarters of Java Cava would make a rupiah loan of equivalent value to the headquarters of Stars and Stripes. The parent corporations would then make intracompany loans to their subsidiaries. A back-to-back loan involves only a single loan document and contains a provision for the **right of offset**, a clause that stipulates that if one party defaults on a payment, the other party can withhold corresponding payments of equal value. Because the exchange control regulations of many countries explicitly prohibit rights of offset, parallel loans are more common than back-to-back loans.

The World Bank–IBM Swap

In 1981, the World Bank and IBM engaged in one of the first currency swaps. The World Bank had substantial outstanding debt denominated in dollars as well as in Deutsche marks and Swiss francs. It considered its liabilities to be unbalanced and wanted to reduce its dollar debt and increase its Deutsche mark and Swiss franc debt. Although it could have issued additional debt in the European currencies and retired its dollar debt, the World Bank was near its official borrowing limit in the European currencies. Meanwhile, IBM had outstanding debts denominated in Deutsche marks and Swiss francs, but the company wanted the debt denominated in dollars. Why? Because much of IBM's revenue was generated in dollars, and the firm was worried that the dollar would soon depreciate, making it relatively more difficult for IBM to repay its Deutsche mark– and Swiss franc–denominated debt.

It occurred to smart financial advisors that the World Bank and IBM could both benefit by swapping their debts. The result was that the World Bank agreed to take over IBM's Deutsche mark and Swiss franc debt service in return for IBM taking over the World Bank's dollar debt service. Since then, the swap market has grown tremendously, and interest rate and currency swaps have become indispensable risk management tools for multinational corporations.

Basic Aspects of Currency Swaps and Interest Rate Swaps

A **currency swap** allows a multinational corporation to change the currency of denomination of its debts, as the World Bank and IBM did. Exhibit 21.1 presents the basic idea of a currency swap. Counterparty A is paying interest and principal on a dollar amount to Counterparty B. Counterparty B, in turn, is paying interest and principal on a yen amount to Counterparty A. At the beginning of the swap, the dollar principal is equal to the yen principal. These principals will again be exchanged at the end of the currency swap, but if the exchange rate has changed, the values of the principals will no longer be equal at the end of the swap.

Exhibit 21.1 Foreign Currency Swap Diagram

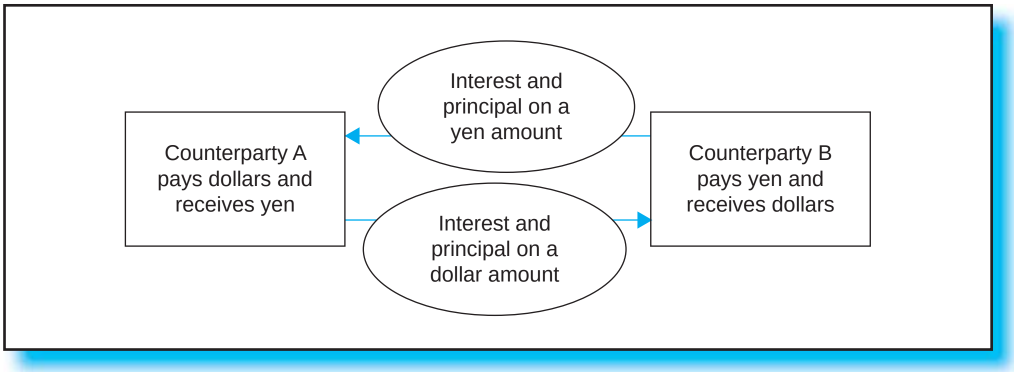
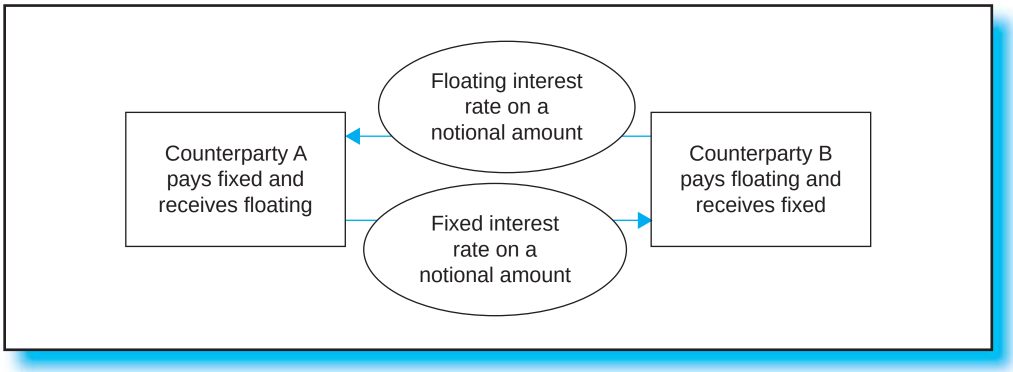


Exhibit 21.2 Interest Rate Swap Diagram



An **interest rate swap** allows a multinational corporation (MNC) to change the nature of its debt from a fixed interest rate to a floating interest rate or from a floating interest rate to a fixed interest rate. Exhibit 21.2 provides a basic interest rate swap diagram. Counterparty A is paying a fixed amount of interest on a **notional principal** to Counterparty B, and Counterparty A is receiving floating interest rate cash flows on the same notional amount from Counterparty B. The term *notional* indicates the basic principal amount on which the cash flows of the interest rate swap depend. Unlike a currency swap, no exchange of principal is necessary because the principal is an equal amount of the same currency.

The Size of the Swap Markets

The growth in the use of swaps since their introduction in the early 1980s has been truly phenomenal. Exhibit 21.3 presents Bank for International Settlements (BIS) data on the outstanding amounts of interest rate and currency swaps. Notice that the notional amount of interest rate swaps on the books of corporations and banks around the world in 2010 was $347 *trillion* dollars, whereas in 2001, the notional value of aggregate interest rate swaps was $51 trillion, an annualized growth rate of over 23%. These figures are adjusted for the obvious double-counting problem that arises because each contract is counted on the books of two counterparties. The notional value of currency swaps is significantly smaller than the notional value of interest rate swaps, but it was still an incredibly large $16.3 trillion in June 2010.

In thinking about these notional values, it is important to understand that, like forward contracts, interest rate swaps and currency swaps begin life as zero net present value contracts. That is, swaps have no market value initially because the present value of the cash

Exhibit 21.3 The Size and Growth of Interest Rate and Currency Swap Markets (amounts outstanding in billions of U.S. dollars)

	Currency Swaps		Interest Rate Swaps		Credit Default Swaps	
	Notional Amounts	Gross Market Value	Notional Amounts	Gross Market Value	Notional Amounts	Gross Market Value
June 2001	3,823	314	51,407	1,404	—	—
June 2004	7,033	442	127,570	3,562	—	—
June 2007	12,291	617	271,853	5,315	42,580	721
June 2010	16,347	1,187	347,508	15,951	30,261	1,666

Note: Data are taken from various December issues of the Bank for International Settlements *Quarterly Review*.

flows that are to be paid by one of the counterparties is exactly equal to the present value of the cash flows that are to be paid by the other counterparty. Subsequently, though, changes in interest rates and especially exchange rates imply that one of the counterparties to the swap experiences a profit and the other experiences an equivalent loss.

Exhibit 21.3 also shows that the gross market value of the outstanding interest rate swaps in 2010 was 4.59% of the notional value, or $15.951 trillion, whereas the market value of outstanding currency swaps was 7.26% of notional value, or $1.187 trillion. These are the market values of the debts that are owed between counterparties at that time.

As you can see from Exhibit 21.3, interest rate and particularly currency swaps can become quite valuable. Of course, value created on one side of a swap is a loss when viewed from the other side. So, swaps can be the source of large trading losses, especially when they are being used for speculative purposes. For example, in 1998, the hedge fund Long Term Capital Management (LTCM) lost $1.6 billion on trades in the swap markets, and it lost more than $4 billion in total, causing the Federal Reserve Bank of New York to organize a $3.6 billion bailout of LTCM counterparties to prevent a crisis [see Lowenstein (2000)]. The LTCM crisis brought home the fact that the counterparty risk of swaps can be substantial, and the same marking-to-market techniques that are used in the futures market have become common in the swap market to mitigate these risks.

Some market observers have argued that the growth rate of the swap market has been too fast and that the magnitudes outstanding in the swap markets were a financial catastrophe waiting to happen. However, the 2007 to 2010 global financial crisis taught the financial community that a rapidly growing new category of swaps, namely credit default swaps, posed a much larger danger for financial stability.

Credit Default Swaps and the Financial Crisis

The **credit default swap (CDS)** was devised by JPMorgan Chase bankers. It is essentially a bilateral insurance contract between a protection buyer and a protection seller to protect against default on a specific bond or loan issued by a corporation or sovereign (the "reference entity"). The protection buyer pays semiannual or annual insurance premiums to the protection seller. In return, when there is a default event, the protection seller transfers value to the protection buyer. Value is transferred either through physical settlement or cash settlement. If there is physical settlement, the protection buyer delivers the defaulted bond to the protection seller who pays the face amount of the referenced bond. If there is cash settlement, the protection seller pays the buyer the difference between the face value of the bond and the value of the defaulted bond. The insurance analogy is apt in the case of physical settlement because the CDS contract protects the owner of the bond in the event of default, but with cash settlement, the CDS is just another derivative contract that allows market participants to trade and transfer the credit risks of corporations and sovereigns.

The CDS market remained very small in the 1990s, but it grew exponentially in the first decade of the 21st century, reaching notional open interest of $60 trillion in 2008 (see Exhibit 21.3 for more data on outstanding amounts). The rapid growth meant that many of the contracts were speculative in nature. Institutional investors, including insurance companies, and hedge funds became major players in the CDS market. Some skeptical market observers noted that the market was entirely unregulated and was analogous to letting someone who you do not know take an insurance contract out on your house, and when it is destroyed by a fire, having the unknown person get paid the value of the house.

Substantial amounts of credit default swaps were written on subprime mortgages, and when defaults began to increase in 2007 and 2008, the dangers inherent in the CDS market soon became very clear. One of the most important sellers of CDS protection was the American International Group (AIG), one of the oldest and most venerable American insurance companies. AIG had written (sold) over $440 billion worth of CDS on corporate bonds, loans (including those of Lehman Brothers), and mortgage-backed securities. As AIG began to take losses, the firm's credit rating was downgraded and it faced massive collateral calls. In September 2008, the U.S. government arranged an $85 billion secured credit facility in one of the largest bailouts of a company in U.S. history.

Not surprisingly, in the aftermath of the crisis, governments around the world are considering regulating the over-the-counter derivative markets, asking for more transparency, clearing by central counterparties as on an exchange, and perhaps higher capital charges for derivative transactions by banks. The United States passed the Dodd–Frank act in 2010, which included financial regulation, but how the regulations will actually be concretely implemented and what the effects will be on interest rate and currency swaps remain to be seen.

21.2 Interest Rate Swaps

Interest rate swaps allow corporations to manage their interest rate risk or to speculate on the direction of interest rates. In this section, we first discuss the cash flows associated with interest rate swaps. Then, we discuss why a corporation might prefer floating-rate debt to fixed-rate debt or vice versa, which is related to the issue of the choice of debt contracts in Chapter 11. We then discuss why interest rate swaps would be used in a world where many different debt contracts are available. We begin with an example of an interest rate swap between Jocko Sports and Banco Coloro.

Example 21.1 A 5-Year Interest Rate Swap

Suppose Jocko Sports is paying the floating-rate side of a dollar interest rate swap and receiving fixed interest rate payments from Banco Coloro. Let the notional principal on the 5-year swap be $25 million, and let the fixed interest rate be 8%. Because Banco Coloro pays the fixed interest rate side of the swap, it would owe 10 semiannual payments for 5 years of

$$0.5 \times 0.08 \times \$25 \text{ million} = \$1 \text{ million}$$

In return, Jocko Sports would pay Banco Coloro semiannual interest payments on $25 million at the London Interbank Offered Rate (LIBOR), that is LIBOR $\times$ $25 million.

Usually, only a net interest payment is transferred between the two parties because the currency is the same. That is, the party with the higher interest rate pays the net interest payment to the party with the lower interest rate. For example, suppose the current 6-month LIBOR is 10% p.a. Because Jocko Sports is paying the LIBOR rate of 10% and receiving the fixed rate of 8%, Jocko Sports must pay the de-annualized 2% net interest rate payment on the $25 million, or

$$0.5 \times 0.02 \times \$25 \text{ million} = \$250{,}000$$

Why Use Interest Rate Swaps?

Fixed Versus Floating-Rate Debt

Many corporations have revenue cash flows that are pro-cyclical, which means their revenues are high during booms and low during recessions. Short-term interest rates are also pro-cyclical. That is, short-term interest rates tend to rise during expansions in the business cycle and fall during recessions. A corporation whose sales are pro-cyclical can afford to borrow continually in the short-term money market. The corporation does not mind making high interest rate payments during a boom because its revenues are high, too. During recessions, the corporation likes its interest costs to be low because its revenues are relatively lower as well. But if the corporation borrows at long-term fixed rates, its fixed interest costs are a higher percentage of its cash flows during contractions in business cycles than during expansions. This cyclical pattern increases the corporation's risk of default.

One danger of borrowing short term, though, is that the lender may refuse to renew the loan agreement when the circumstances of the corporation change for the worse. Hence, there is a corporate demand for long-term contracts that have floating-rate payments. Banks are happy to provide long-term contracts with floating interest rates. Although banks' liabilities are mostly short term, and the interest rates they pay on their deposits fluctuate, the banks' deposit bases are often quite stable. This allows banks to enter into relatively long-term contracts to receive floating interest rate cash flows. In addition, many investors prefer the certainty of long-term, fixed interest rate debt. Some borrowers, such as corporations with stable revenues, can afford to make fixed-rate payments during both booms and recessions. Thus, there are demands and supplies for all types of interest rate contracts, and all types of interest rate contracts exist.

Changed Circumstances

Although a company might have rationally determined that a long-run, fixed-rate debt was the right type of loan to take out when a debt was initially issued, over time, the firm's circumstances might change. For example, suppose the company subsequently forecasts that its cash flows are likely to deteriorate at a time when short-term interest rates are low. In this case, the firm can perhaps stave off its difficult financial situation by swapping out of its fixed-rate debt and into a short-term debt with a lower interest rate.

Alternatively, consider a firm that typically borrows with floating-rate debt because its cash flows are cyclical. After the firm acquires another company, the combined firm's cash flows might become much less cyclical. This could prompt the company's managers to swap from floating-rate debt to fixed-rate debt.

Views on the Future

While we have stressed the risk management role of derivative contracts, it is no secret that the treasury departments of major corporations often place bets on the direction of interest rates, currencies, and other financial variables. When managers view future short-term interest rates as unusually low, they may try to lower the company's interest costs by converting its existing fixed-rate debt into floating-rate debt. Alternatively, if they forecast that interest rates are going to rise, they may want to swap out of floating-rate debt and into fixed-rate debt. Chernenko and Faulkender (forthcoming) find empirical evidence that firms use interest rate swaps to both hedge and speculate. Speculation is particularly prevalent in firms where executive compensation contracts are more performance sensitive, a fact confirmed by survey evidence in Geczy et al. (2007).

Minimizing the Cost of Debt

As indicated in Chapter 11, corporations can fund their projects in a number of ways: via bank loans, floating-rate debt, Eurobonds, and so forth. When a company's financing needs are large, shaving a few basis points off the cost of debt can mean millions of dollars in cost savings. Hence, a large corporation figures out what kind of debt it ultimately wants, it determines the cheapest way to raise the funds, and it uses the swap market to convert the actual debt into the desired debt.

Research is beginning to find support for this view. For example, Li and Mao (2003) find that certain firms with low or no credit ratings are relegated by the markets to borrowing from banks that make floating-rate loans because the banks do not want to risk lending to these firms at fixed rates. Nevertheless, these firms can then enter into interest rate swaps as fixed-rate payers to eliminate their exposure to interest rate risk. By doing so, the lowly rated firms are able to effectively borrow at fixed rates.

Manipulating Earnings

Another use of swaps that has been discussed in the literature involves their use by management to manipulate earnings. Chernenko et al. (2007) present some empirical evidence that swap activity is partially driven by the desire of managers to manipulate the earnings of firms so as to meet their earnings forecasts and keep their pay high. If the term structure is upward sloping, initializing a fixed to floating swap increases a firm's net income by a predictable amount in the first year. However, the authors also show that financial markets at least partially discern the differences between earnings derived from normal operations versus earnings derived from this type of "window-dressing" swap activity.

The Nature of Interest Rate Swap Contracts

Major commercial and investment banks serve as market makers for interest rate swaps by quoting bid–offer rates for various maturities at which they are willing to swap fixed interest rate debts for floating interest rate debts or floating interest rate debts for fixed interest rate debts. By convention, the quotes in the dollar interest rate swap market usually use 6-month LIBOR as the base rate of the floating-rate side of the transaction. The bank's bid interest rate

Inverted Swap Spreads?

The 2007 to 2010 global financial crisis generated potentially anomalous pricing behavior in the swap markets. Since mid-2008 in the United Kingdom, and a bit later in other euro area countries and the United States, yields on long-term Treasury bonds have been higher than swap rates of the same maturity. One partial explanation is the change in relative credit risk across markets. With the global financial crisis and the sovereign debt crisis in Europe, government debt is not necessarily viewed as default free, and CDS markets charge a premium even to insure U.S. government debt. For example, on April 20, 2011, CNBC quoted premiums for 5-year CDSs on U.S. and U.K. government debt of 46 and 61 basis points, respectively. Parenthetically, the countries embroiled in the European sovereign debt crisis traded at much larger premiums, ranging from 241 basis points for Spain to 852 basis points for Greece.

At the same time, the credit risk of an interest rate swap is different than that of a bond because only the differential cash flows are at risk and the value of a swap is much less than the notional principal and varies through time (see Exhibit 21.3). Moreover, swaps are now often fully or partially collateralized with cash or government bonds, further reducing credit risk. Yet, bonds issued by banks still carry higher spreads than government bonds of a similar maturity. Can the differential risk exposure really change the sign of relative credit risk on government bonds versus interest rate swaps?

It remains somewhat puzzling why nobody would (1) borrow at LIBOR, (2) take out an interest rate swap that receives LIBOR (to pay off the LIBOR loan) and pays fixed, and (3) invest in a government bond, paying a higher interest rate than the fixed side of the interest rate swap. Perhaps this trade has become too costly, and surely not every bank can borrow at LIBOR (or hope to continue to do so for a long time). Also, while LIBOR borrowing is unsecured, the swap requires collateralization, which may be costly. Another reason is suggested by Laurence Mutkin, a Morgan Stanley interest rate strategist: The arbitrage uses up too much "balance sheet." He thinks the negative swap spreads are here to stay because they reflect an additional difference between bonds and swaps, which he calls the cost of "balance sheet rent." When an institution buys a government bond, bank capital must be used because the bond appears on the institution's balance sheet. However, swaps are off balance sheet items, so they allow long exposure to interest rates without using "balance sheet capital," and are therefore more competitively priced.

is the fixed rate that the bank is willing to pay over a given maturity in return for receiving semiannual payments corresponding to 6-month LIBOR. The bank's higher offer, or ask, interest rate is the fixed rate that the bank will receive from a counterparty over a given maturity if the bank is to pay 6-month LIBOR to that counterparty.

In the case of the U.S. dollar, the bank's fixed bid and offer interest rates are often quoted in terms of a **swap spread**—that is, a number of basis points that are added to the yield to maturity on a U.S. government bond corresponding to that maturity. The swap spread reflects differences in credit quality of the private sector relative to the U.S. Treasury and the liquidity differences in the markets.

Notional Principal

As noted earlier in this chapter, the actual interest payments in an interest rate swap are based on what is called a notional principal. The notional principal is the amount of the outstanding debts. In an interest rate swap, the underlying currency is the same for the two parties of the transaction. Hence, there is no exchange of principal at the beginning or end of the transaction because these amounts are identical and simply cancel one another out.

Bid–Ask Prices for Interest Rate Swaps

Assume that at the 5-year maturity, the market sets the price of U.S. Treasury bonds to have a yield to maturity of 5.66% p.a. Consider the following indicative bid–ask quotes on an interest rate swap. The bank structures the bid side of its swap as the yield on Treasury bonds plus a swap spread of 55 basis points. Thus, the bank is willing to pay fixed-rate interest payments to a high-quality corporate customer at

$$5.66\% + 0.55\% = 6.21\%$$

In return, the bank receives a floating-rate payment from the corporation equal to 6-month LIBOR. The bank structures the offer side of its swap as the yield on Treasury bonds plus 60 basis points. The bank is willing to receive fixed interest rate payments from a high-quality corporation for the next 5 years at

$$5.66\% + 0.60\% = 6.26\%$$

In return, the bank is willing to pay interest to the corporation at 6-month LIBOR.

Profits and Risks for Swap Dealers

To the extent that a bank successfully matches the aggregate amount of interest rate swaps for a given maturity in which it must make fixed interest rate payments with the aggregate notional amount on which it receives fixed interest rate payments from its counterparties, the bank will earn the bid–ask spread on that aggregate amount. For example, if the bank has an outstanding notional principal of $100 billion from both sides of these transactions, the bank generates $50 million in revenue per year from the 5-basis-point spread between the bid and offer rates because

$$0.0005 \times \$100 \text{ billion} = \$50 \text{ million}$$

Notice, though, that if there is a mismatch between the aggregate notional amounts on which the bank is paying the fixed rate versus receiving the fixed rate, the bank is exposed to interest rate risk. Suppose that at a particular maturity, the value of the Second National Bank of Chicago's contracts to pay LIBOR is larger than the value of Second Chicago's contracts to receive LIBOR. Second Chicago is consequently exposed to interest rate risk because an increase in LIBOR will cause losses. If short-term interest rates rise in the future, Second Chicago will be required to pay interest at a higher rate while continuing to receive contractual long-term interest payments that are fixed. Conversely, if Second Chicago enters into more contracts in which it is paying the fixed rate than in which it is receiving the fixed rate, the bank will experience losses if LIBOR falls. If short-term interest rates fall, Second Chicago must continue to pay interest at the contractually fixed high interest rate while receiving short-term interest payments that are falling.

Dealing with Credit Risks

Of course, the bid–offer rates quoted by banks typically only indicate prices at which the bank is willing to transact with other banks or counterparties with AAA credit risk ratings. Most corporate customers pose a substantial amount of default risk. Consequently, even though interest rate swaps carry the right of offset in that the bank can stop making its side of the payments if the corporation defaults on its side of the transaction, the bank will widen its bid–offer spread in dealing with less creditworthy corporate or institutional customers.

Alternatively, the bank may ask for a credit enhancement in the form of collateral, which is what the International Swaps and Derivatives Association now recommends. The amount of collateral is equal to the mark-to-market value of the swap contract.[1] The increased use of collateral is evidenced in the 2011 ISDA Margin Survey, which reported that almost 150,000 collateral agreements were in place in 2010—up from 70,892 in 2005 and up from only 12,000 in 2000.

A similar problem arises from the corporate perspective. Most corporate customers are not in the business of assessing the credit risks of banks. They therefore want their banking counterparties to have excellent credit ratings. Many commercial banks and investment banks have responded to this demand by establishing subsidiaries, the so-called special purpose vehicles (SPVs), that conduct swap transactions and providing those subsidiaries with enough capital to become AAA rated.

21.3 Foreign Currency Swaps

A currency swap is essentially an agreement between two parties to exchange the cash flows of two long-term bonds denominated in different currencies. The parties exchange initial principal amounts in the two currencies that are equivalent in value when evaluated at the spot exchange rate. Simultaneously, the parties agree to pay interest on the currency they initially receive, to receive interest on the currency they initially pay, and to reverse the exchange of initial principal amounts at a fixed future date.

The principal amount of one of the currencies is determined by negotiation between the two parties, and the corresponding principal amount of the other currency in the swap is set by the prevailing spot exchange rate. For example, suppose one of the parties wants to exchange \$10 million with its counterparty for euros, and the spot exchange rate is \$1.25/€. Then, the euro amount in the swap corresponding to the \$10 million is

$$\$10 \text{ million}/(\$1.25/€) = €8 \text{ million}$$

Currency swaps usually involve both parties exchanging the interest and principal payments. If only a net interest payment from one counterparty to the other is desired, in the beginning, the counterparty that initially receives the high interest rate currency will owe funds to the counterparty that is initially receiving the low interest rate currency. Usually, the interest payments are made semiannually. As the exchange rate changes, though, the value of the fixed interest payments in the different currencies changes, and the net amount paid in the currency swap evolves.

[1]Johannes and Sundaresan (2007) explore the effect that collateral enhancement has on the pricing of interest rate swap contracts.

Example 21.2 Michaelone's Currency Swap with Margon Stonely

Suppose that the Italian company Michaelone is the party that initially pays €8 million and receives \$10 million, as we were discussing, and the investment bank Margon Stonely is the counterparty that initially pays \$10 million and receives €8 million. Then, in future periods, Michaelone will owe dollar interest to Margon Stonely on the \$10 million, and Margon Stonely will owe euro interest on the €8 million to Michaelone. Suppose the maturity of the swap is 5 years, and the interest rates for that maturity are 4% on dollars and 6% on euros. Exhibit 21.4 describes the corresponding cash flows. Twice per year for 5 years, Margon Stonely, the initial receiver of euros, would owe Michaelone semiannual euro payments of

$$0.5 \times 0.06 \times €8 \text{ million} = €240{,}000$$

Michaelone, the initial receiver of dollars, would owe semiannual dollar payments to Margon Stonely of

$$0.5 \times 0.04 \times \$10 \text{ million} = \$200{,}000$$

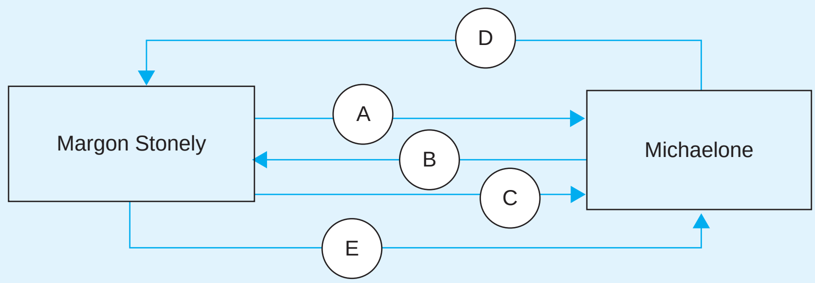
If the exchange rate did not move from the original value of \$1.25/€ by the time an interest payment was due, the euro value of the \$200,000 would be $€160{,}000 = \$200{,}000/(\$1.25/€)$. Because this is fewer euros than Michaelone is to receive from Margon Stonely, if only a net interest payment is being made, Margon Stonely would be required to pay Michaelone the net interest payment of

$$€240{,}000 - €160{,}000 = €80{,}000$$

In actuality, the net interest payment made by Margon Stonely to Michaelone would depend on the evolution of the exchange rate. At a future payment date $t+k$, the net interest payment would be the €240,000 owed minus the euro value of \$200,000:

$$€240{,}000 - \$200{,}000/S(t+k, \$/€)$$

Exhibit 21.4 The Cash Flows of a Currency Swap



Notes: The currency swap diagram summarizes the transactions and various cash flows:

A. Margon Stonely gives \$10 million to Michaelone. The U.S. dollar interest rate is 4%. Michaelone will owe semiannual interest payments of $0.5 \times 0.04 \times \$10 \text{ million} = \$200{,}000$.

B. Michaelone gives Margon Stonely €8 million in exchange for the \$10 million in A. The exchange rate is \$1.25/€. The euro interest rate is 6%. Margon Stonely will owe semiannual interest payments of $0.5 \times 0.06 \times €8 \text{ million} = €240{,}000$.

C. A semiannual net interest payment of $€240{,}000 - [\$200{,}000/S(t+k, \$/€)]$ is made from Margon Stonely to Michaelone as long as the spot exchange rate $S(t+k, \$/€) > \$0.8333/€$. If the exchange rate falls below this value, the net payment flows from Michaelone to Margon Stonely.

D. In the final period, Michaelone must repay the \$10 million to Margon Stonely.

E. In the final period, Margon Stonely must repay the €8 million to Michaelone.

Notice that if the dollar strengthened relative to the euro to an exchange rate that is smaller than $\$0.8333/€ = \$200{,}000/€240{,}000$, the euro value of the \$200,000 would be greater than €240,000. Consequently, a net dollar payment would have to be made from Michaelone to Margon Stonely. For example, at the exchange rate of \$0.75/€, Michaelone would owe Margon Stonely

$$\$200{,}000 - (\$0.75/€) \times €240{,}000 = \$20{,}000$$

Although currency swaps were originally special contracts, they have now become standardized products of financial intermediaries. The next section explains how modern currency swaps are quoted and traded.

The Mechanics of Modern Currency Swaps

As the market for U.S. dollar interest rate swaps and currency swaps grew and participants searched for ways to standardize these contracts, financial intermediaries began to quote bid–offer rates for fixed foreign currency interest rates at which they were willing to swap versus paying or receiving floating interest rate payments given by the 6-month dollar LIBOR. Consider the following quotations on 5-year fixed interest rate and currency swaps that might be offered by the Commercial Credit Bank:

U.S. Dollars: 5.25% bid and 5.35% offered against 6-month dollar LIBOR
British Pounds: 8.00% bid and 8.10% offered against 6-month dollar LIBOR

Notice that the first of these quotations for the U.S. dollar is just an interest rate swap. The second quote involves a transformation of both the currency and the interest rate. Commercial Credit is willing to pay to its counterparty either the fixed interest rate of 5.25% in U.S. dollars or 8.00% in pounds against receiving 6-month dollar LIBOR from its counterparty. Commercial Credit is also willing to receive from its counterparty the fixed interest rates of 5.35% in dollars or 8.10% in pounds against paying 6-month dollar LIBOR to its counterparty. Because Commercial Credit is willing to participate on either side of these transactions versus 6-month dollar LIBOR, one can easily structure a currency swap between fixed-rate pounds and fixed-rate U.S. dollars. Example 21.3 and Exhibit 21.5 illustrate how a currency swap can be structured with these quoted rates.

Example 21.3 Floyds' Currency Swap with Commercial Credit Bank

Suppose a large insurer such as Floyds has outstanding pound debt and wants to swap into fixed-rate dollar debt because its U.S. business has grown. Let the principal amount be £200 million, which corresponds to \$360 million at a spot exchange rate of \$1.8/£. Because Floyds wants to pay dollar interest to Commercial Credit Bank, Floyds will swap at an interest rate of 5.35%, the offer rate quoted by the bank when it receives dollars in return for paying interest at the 6-month LIBOR. This part of the transaction is an interest rate swap. The cash flows are represented in Part 1 of Exhibit 21.5. Because the fixed-rate payments are made semiannually, the dollar interest payments are

$$0.5 \times 0.0535 \times \$360 \text{ million} = \$9.63 \text{ million}$$

In the other part of the transaction, Floyds wants to receive pound interest payments from Commercial Credit. The bank is willing to do this at 8.00%, its bid rate, in return for receiving floating-rate dollar payments from Floyds. The cash flows for the second

Exhibit 21.5 The Cash Flows for Floyds from a Currency Swap

	Part 1		Part 2	
Time Period	Floyds Pays the \$ Fixed Rate	Floyds Receives the \$ Floating Rate	Floyds Pays the \$ Floating Rate	Floyds Receives the £ Fixed Rate
Year 0			\$360,000.000	(£200,000.000)
Year 0.5	(\$9,630.000)	LIBOR × \$360 m	(LIBOR × \$360 m)	£8,000.000
Year 1.0	(\$9,630.000)	LIBOR × \$360 m	(LIBOR × \$360 m)	£8,000.000
Year 1.5	(\$9,630.000)	LIBOR × \$360 m	(LIBOR × \$360 m)	£8,000.000
Year 2.0	(\$9,630.000)	LIBOR × \$360 m	(LIBOR × \$360 m)	£8,000.000
Year 2.5	(\$9,630.000)	LIBOR × \$360 m	(LIBOR × \$360 m)	£8,000.000
Year 3.0	(\$9,630.000)	LIBOR × \$360 m	(LIBOR × \$360 m)	£8,000.000
Year 3.5	(\$9,630.000)	LIBOR × \$360 m	(LIBOR × \$360 m)	£8,000.000
Year 4.0	(\$9,630.000)	LIBOR × \$360 m	(LIBOR × \$360 m)	£8,000.000
Year 4.5	(\$9,630.000)	LIBOR × \$360 m	(LIBOR × \$360 m)	£8,000.000
Year 5.0	(\$9,630.000)	LIBOR × \$360 m	(\$360,000.000 + LIBOR × \$360 m)	£200,000.000 + £8,000.000

Notes: The interest rate at which Commercial Credit receives fixed dollar payments is 5.35% p.a., and $(0.5) \times (0.0535) \times \$360$ million $= \$9.63$ million. The interest rate at which Commercial Credit makes fixed pound payments is 8.00% p.a., and $(0.5) \times (0.08) \times £200$ million $= £8$ million.

part of the transaction are under Part 2 of Exhibit 21.5. Because the fixed-rate pound payments are received semiannually, the pound interest receipts are

$$0.5 \times 0.08 \times £200 \text{ million} = £8 \text{ million}$$

Because this part of the transaction involves a change of currencies, the principal amounts are exchanged both at the beginning of the swap and in the reverse direction at the end of the 5 years. Hence, in the final period, Floyds must pay the \$360 million principal in addition to its final dollar interest payment, and it will receive £200 million plus its final pound interest receipt from Commercial Credit. Notice that the dollar LIBOR receipts in Part 1 are equal to the dollar LIBOR payments in Part 2. Hence, Floyds has swapped out of fixed pound debt payments into fixed dollar debt payments. Floyds can then use the pound principal and interest received from Commercial Credit to pay the bondholders of its pound-denominated debt.

In Example 21.3, Floyds is content to transact at the quoted rates provided by Commercial Credit. But because the cash flows on a corporation's debt will typically not exactly equal the cash flows from the swap quoted by the financial intermediary, some residual foreign exchange risk can be present.

Later in this chapter, we will consider an extended example that shows how the cash flows of a swap can be adjusted to eliminate the exchange rate risk. First, though, we examine how a currency swap would have been done in the 1980s when financial intermediaries first arranged deals that allowed firms to issue bonds in one currency and then swap the cash flows with a firm that had issued bonds in a different currency. This first part of the example introduces the important concept of comparative advantage in borrowing.

Comparative Borrowing Advantages in Matched Currency Swaps

The Goodweek–Bridgerock Situation

Consider two tire companies, Goodweek and Bridgerock, which both want to issue 5-year, fixed-rate debt. Suppose Goodweek wants to raise approximately \$200 million, and Bridgerock

Exhibit 21.6 Possible Bond Issues for Goodweek and Bridgerock

	Dollar Bond Issues		Euro Bond Issues	
Goodweek	200 Million @ 8.5% with 1.875% Fee		100 Million @ 13.5% with 2.25% Fee	
Bridgerock	200 Million @ 9.5% with 1.875% Fee		100 Million @ 13.75% with 2.25% Fee	
Year	**Goodweek's Cash Flows**	**Bridgerock's Cash Flows**	**Goodweek's Cash Flows**	**Bridgerock's Cash Flows**
0	196.25	196.25	97.75	97.75
1	−17.00	−19.00	−13.50	−13.75
2	−17.00	−19.00	−13.50	−13.75
3	−17.00	−19.00	−13.50	−13.75
4	−17.00	−19.00	−13.50	−13.75
5	−217.00	−219.00	−113.50	−113.75
All-In Cost	8.98%	9.99%	14.16%	14.41%

Note: Yearly cash flows are in millions of dollars or euros.

wants to raise €100 million, which is equal to $200 million at the current exchange rate of $2/€. Exhibit 21.6 shows the possible bond issues that the two firms are considering.

Investment bankers are quoting dollar interest rates of 8.5% for Goodweek and 9.5% for Bridgerock, with annual interest payments. Both companies would have to pay a 1.875% fee to the banks for their help in issuing the bonds. Hence, if $200 million of bonds were issued at par, the proceeds to the two firms would be

$$(1 - 0.01875) \times \$200 \text{ million} = \$196{,}250{,}000$$

The annual coupon payments for Goodweek would be

$$0.085 \times \$200 \text{ million} = \$17{,}000{,}000$$

Bridgerock would make annual coupon payments of

$$0.095 \times \$200 \text{ million} = \$19{,}000{,}000$$

The all-in cost (AIC) of a debt issue (see Chapter 11) is the internal rate of return on the company's cash flows given by the net proceeds to the firm in year 0 as an inflow and given the coupon interest payments made in years 1 through 5 and the final return of principal in year 5 as outflows. If Goodweek does the dollar debt issue, its AIC is 8.98%. If Bridgerock does the dollar debt issue, its AIC is 9.99%.

It is also possible for the two firms to issue euro-denominated debt, in which case the size of the issue must be €100 million in order to raise $200 million. Investment bankers are quoting euro interest rates of 13.5% for Goodweek and 13.75% for Bridgerock. In both cases, there would be a 2.25% fee, and the proceeds of the issue to either firm would be

$$(1 - 0.0225) \times €100{,}000{,}000 = €97{,}750{,}000$$

or $195,500,000 at the current exchange rate of $2/€. The annual coupon payments for Goodweek would be

$$0.135 \times €100{,}000{,}000 = €13{,}500{,}000$$

Bridgerock would make annual coupon payments of

$$0.1375 \times €100{,}000{,}000 = €13{,}750{,}000$$

Exhibit 21.6 indicates that if Goodweek does the euro debt issue, its AIC is 14.16%. If Bridgerock does its euro debt issue, its AIC is 14.41%.

How should the firms choose the currency of denomination of their bonds? We need to consider their hedging motives as well as the direct AICs of the different debts. Suppose

Goodweek would like to have euro debt because it has positive euro cash flows from the sales of its products in Europe. The euro debt would provide a partial hedge to the revenue stream from Goodweek's European sales. Suppose, analogously, that Bridgerock would like to have dollar debt because it has positive dollar cash flows from the sales of its products in the United States. Given the firms' hedging motives, each firm could issue the bonds denominated in its preferred currency. In this case, Goodweek would issue euro bonds, and Bridgerock would issue U.S. dollar bonds. But, as we will demonstrate, this is inefficient given the quoted AICs.

Absolute Versus Comparative Advantage

With the bond yields quoted in Exhibit 21.6, Goodweek has an **absolute borrowing advantage** in both currencies because its AICs are lower in both currencies, but Bridgerock has a comparative borrowing advantage when it comes to issuing euro debt. This implies that Goodweek has a comparative borrowing advantage in issuing U.S. dollar debt.

What does it mean for Bridgerock to have a **comparative borrowing advantage** in issuing euro debt? Because neither firm is borrowing at the risk-free rate, investors have demanded a default premium, which is built into the quoted rates and the AICs. If the firms borrow dollars, Bridgerock must pay 9.99%, an additional 101 basis points compared to 8.98% for Goodweek. If the two firms borrow in euros, Bridgerock must pay only an additional 25 basis points—14.41% for Bridgerock versus 14.16% for Goodweek. Because euro interest rates are higher than dollar interest rates, the euro is at a discount relative to the dollar. Consequently, a euro basis point in the future is actually worth less than a dollar basis point in the future. If the relative borrowing costs in the two currencies were the same for the two companies, the number of euro basis points corresponding to 101 dollar basis points would have to be higher, not lower, than 101.

The euro debt of Bridgerock is being priced by the market more favorably than its dollar debt, and this means Bridgerock has a comparative advantage borrowing in euros, and Goodweek has a comparative advantage borrowing in dollars. Later on, we will discuss the possible sources of these comparative advantages. For now, let's examine how both firms can benefit by issuing debt in the currency in which they have a comparatively cheaper borrowing cost and then doing a currency swap. Bridgerock will consequently issue euro debt, and Goodweek will issue dollar debt. A financial intermediary then matches up the two parties and ensures that eventually Goodweek has its desired euro debt and Bridgerock its desired dollar debt.

Using a Financial Intermediary in a Currency Swap

Can an investment bank such as Bank Carribus do the Goodweek–Bridgerock currency swap and still make money? The answer is yes because currency swaps were originally handled this way until the mid-1980s. Financial intermediaries would know of two counterparties that could benefit by swapping the interest and principal payments on bonds denominated in different currencies. The financial intermediary would arrange the swap, act as counterparty for both firms, and walk away with a handsome profit.

Exhibits 21.7 demonstrates how the cash flows for a currency swap could be structured for Goodweek, Bridgerock, and Bank Carribus. Exhibit 21.8 provides a summary diagram of the cash flows and the AICs. The currency swap begins with each firm issuing bonds denominated in the currency in which it has a comparative borrowing advantage: Goodweek issues a dollar-denominated bond to investors, and Bridgerock issues a euro-denominated bond to investors.

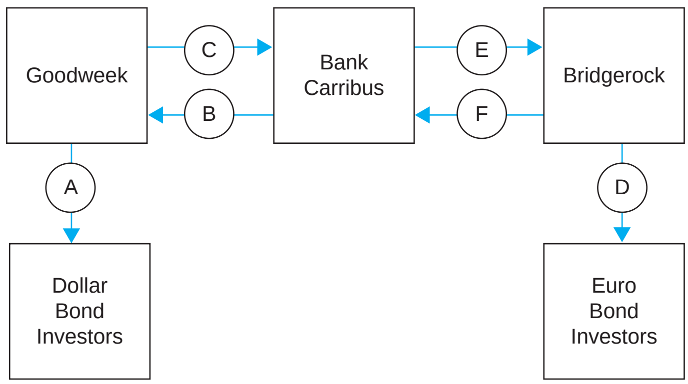
Bank Carribus wants each firm to make the interest and principal payments associated with the bond issue of the other company in return for receiving cash flows that are equivalent to the interest and principal payments that each firm owes its bondholders. What must be determined is how much money will change hands initially, at the beginning of the swap. This initial transfer determines the AICs of the swap to each company.

Exhibit 21.7 Swaps with Bank Carribus as the Financial Intermediary

	Goodweek's Cash Flows			Bridgerock's Cash Flows			Bank Carribus's Cash Flows	
		Swap with Bank Carribus			Swap with Bank Carribus		Net	
Year	$ Bond Issue	Dollar	Euro	€ Bond Issue	Dollar	Euro	Dollar	Euro
0	196.25	−196.25	99.83	97.75	191.57	−97.75	4.86	−2.08
1	−17.00	17.00	−13.75	−13.75	−17.00	13.75	0.00	0.00
2	−17.00	17.00	−13.75	−13.75	−17.00	13.75	0.00	0.00
3	−17.00	17.00	−13.75	−13.75	−17.00	13.75	0.00	0.00
4	−17.00	17.00	−13.75	−13.75	−17.00	13.75	0.00	0.00
5	−217.00	217.00	−113.75	−113.75	−217.00	113.75	0.00	0.00
AIC	8.98%	8.98%	13.80%	14.41%	9.60%	14.41%		
					Bank Carribus's net dollar profit		0.5206	

Note: All cash flows are in millions of dollars or euros.

Exhibit 21.8 Intermediated Currency Swap Diagram



Notes: The currency swap diagram summarizes the rates of return and the various cash flows:

A. Goodweek issues $200 million of bonds to investors with 8.5% coupons. After fees of 1.875%, the AIC is 8.98%.

B. Goodweek gives the net proceeds of the bond issue, $196.25 million, to Bank Carribus in exchange for €99.83 million, which is the present value at 13.80% of the € cash flows given in C. Goodweek receives from Bank Carribus the dollar interest and principal payments that it owes to bondholders in A.

C. Goodweek makes the euro payments to Bank Carribus of the interest and principal associated with the bond issue of Bridgerock in D that has an AIC of 13.80%.

D. Bridgerock issues €100 million of bonds with 13.75% coupons. After fees of 2.25%, the company's AIC is 14.41%.

E. Bridgerock gives the net proceeds of the debt, €97.75 million, to Bank Carribus in exchange for $191.57 million, which is the present value at 9.60% of the dollar cash flows given in F. Bridgerock receives from Bank Carribus the euro interest and principal payments that it owes to bondholders in D.

F. Bridgerock makes payments to Bank Carribus of the dollar payments of interest and principal with an AIC of 9.60% associated with the bond issue of Goodweek in A.

If it participates in the currency swap, Goodweek receives dollar interest and principal from Bank Carribus that exactly match the cash flows that Goodweek owes its bondholders. In return, Goodweek pays Bank Carribus the sequence of euro cash flows associated with Bridgerock's bond issue. Bank Carribus then gives these euro cash flows to Bridgerock, and Bridgerock makes the dollar interest and principal payments to Bank Carribus that are equivalent to the cash flows associated with Goodweek's dollar debt.

The challenge for Bank Carribus is to make the swapping of these cash flows attractive to both counterparties. It can do this by quoting an AIC to Goodweek for the euro cash flows the firm will pay to Bank Carribus that is less than 14.16%, Goodweek's direct AIC. It must also quote an AIC to Bridgerock for the dollar cash flows that Bridgerock will pay Bank Carribus that is less than Bridgerock's direct borrowing cost of 9.99%. These interest rates are the opportunity costs of the respective firms of borrowing directly in their desired currencies.

Exhibit 21.7 is structured with quotes from Bank Carribus of 13.80% in euros for Goodweek and 9.60% in dollars for Bridgerock. The euro interest rate of 13.80% is used to discount the sequence of euro cash flows that Goodweek will make to Bank Carribus. In exchange for the \$196,250,000 raised in the bond issue, Goodweek gets the present value of the euro cash flows discounted at 13.80%, which is €99,827,517.60. Similarly, the dollar interest rate of 9.60% is used to discount the sequence of cash flows that Bridgerock will make to Bank Carribus. In exchange for the €97,750,000 raised in its bond issue, Bridgerock gets the present value of the dollar cash flows discounted at 9.60%, which is \$191,574,344.

How much does Bank Carribus make in the deal? At the initiation of the deal, Bank Carribus has a net dollar cash inflow of

$$\$196{,}250{,}000 - \$191{,}574{,}344 = \$4{,}675{,}656$$

and a net euro cash outflow of

$$€99{,}827{,}517.60 - €97{,}750{,}000 = €2{,}077{,}517.60$$

At the current spot exchange rate of \$2/€, the dollar value of the euro outflow is

$$(\$2/€) \times €2{,}077{,}517.60 = \$4{,}155{,}035.20$$

Hence, Bank Carribus makes a net dollar profit of

$$\$4{,}675{,}656 - \$4{,}155{,}035.20 = \$520{,}620.80$$

Bank Carribus's initial euro cash flow must be negative because it must induce Goodweek to make the euro interest and principal payments associated with the Bridgerock bonds. At Bridgerock's borrowing cost of 14.41%, the net proceeds of the euro bond issue are equal in present value to the euro cash flows that Goodweek will pay to Bank Carribus. But Bank Carribus cannot give Goodweek only the net euro proceeds of Bridgerock's bond issue because that would imply an AIC for Goodweek of 14.41%. Because Goodweek can borrow directly in euros at an interest rate of 14.16%, Bank Carribus must offer Goodweek more euros up front than Bank Carribus will receive from Bridgerock's bond issue.

Bank Carribus has an initial positive dollar cash flow because it can keep some of the dollar proceeds of Goodweek's bond issue, which raises the internal rate of return on the cash flows, while offering a dollar AIC to Bridgerock that is lower than Bridgerock's opportunity cost. The reason Bank Carribus has a positive net cash flow is that the currency swap exploits the comparative borrowing ability of each firm, which allows each of the participants, including the financial intermediary, to gain.

Bank Carribus also bears the credit risk of each counterparty, and it must be compensated for bearing this risk. If either Goodweek or Bridgerock stops making its payments to Bank Carribus, Bank Carribus can stop making payments to that firm. Depending on how interest rates and exchange rates have evolved, one of the parties will owe the other a net payment. But Bank Carribus must continue to serve as the financial intermediary for the other side of the deal.

Exhibit 21.9 The Gains from Swapping

	Funding Costs in Different Currencies	
	Dollar	**Euro**
	Before the Swap	
Goodweek	8.98%	14.16%
Bridgerock	9.99%	14.41%
Absolute Spread	101 bp	25 bp
Multiplicative Spread	93 bp	22 bp
	After the Swap	
Goodweek	8.98%	13.80%
Bridgerock	9.60%	14.41%
Absolute Spread	62 bp	61 bp
Multiplicative Spread	57 bp	54 bp

Notes: AICs are reported for loans in dollars and euros before and after the swap. The absolute spread is the difference between the AIC of Bridgerock and the AIC of Goodweek. The multiplicative spread (mcsp) solves

$$(1 + AIC_{Goodweek})(1 + mcsp) = (1 + AIC_{Bridgerock})$$

The Sources of the Gains from a Swap

In the preceding example, Goodweek is clearly considered a better credit risk than Bridgerock in both the dollar and euro bond markets. The top panel in Exhibit 21.9 repeats the AICs for the different bond issues. The differences between the AICs Goodweek faces and the rates Bridgerock faces represents a credit spread (recall the discussion in Chapter 11). The reason Bank Carribus managed to lower the AIC for both Goodweek and Bridgerock with a swap is that it exploited the differential credit spread for the two firms in the dollar versus the euro market.

In Chapter 11, we introduced the concept of a multiplicative credit spread, and the computation is repeated in the notes to Exhibit 21.9. We argued that arbitrage should keep multiplicative spreads in line across countries. In Exhibit 21.9, we show that there is a large difference in the two multiplicative spreads, and it is this difference of 71 basis points that is exploited in the swap.

First, Bridgerock brings its dollar AIC down from 9.99% to 9.60%, lowering its multiplicative spread in the dollar market relative to Goodweek to 57 basis points, which lowers the multiplicative spread by 36 basis points (93 bp to 57 bp). Second, Goodweek lowers its AIC in euros to 13.80%, which increases the multiplicative spread relative to Bridgerock's AIC by 32 basis points (22 bp to 54 bp). The sum of these two "gains" is 68 basis points. This leaves 3 basis points on the table, which constitutes the intermediary fee for Bank Carribus, and the spreads are now almost fully equalized in the two currencies. To see that Bank Carribus is making only a small fee, consider that the bank's profit of $520,620.80 is 0.26% of the $200 million swapped.

Point–Counterpoint

Comparative Advantage in Home Production

Ante, Freedy, and Suttle were visiting their cousin Reid, who is a high school debater. Reid had just opined on the virtues of international trade and why outsourcing is no big deal. At a break in the tournament, Ante said, "I thought comparative advantage was an international trade concept, but Bekaert and Hodrick argue that it motivates currency swaps."

Freedy replied, "Well, I remember comparative advantage from international trade, but I'm not really clear on how it works. I sort of remember that international trade is motivated by differences in technology that provide countries with opportunities for specialization and that specialization is supposed to make everybody better off. That always seemed a little like magic to me, but the logic made me a firm believer in free trade. So, if comparative advantage works in trade, why not in currency swaps?"

As usual, Ante was the denser of the two. "I get it that if it takes 4 hours for me to clean the house and 2 hours to cook dinner, while it takes you 3 hours to clean the house and 3 hours to cook dinner, we're better off with you cleaning the house and me making dinner. That is just comparative common sense. But, if it takes you 5 hours to clean the house and 5 hours to make dinner, which it does by the way, then you're just less productive than I am, and I should just make everything for myself."

Freedy, trying to stay cool, replied, "Well, I don't think you're more productive than I am, but suppose you're right. How would trade work?"

At this point, Suttle Trooth figured he'd better get involved. He said, "Let's take your productivity figures and see who should do what. It takes Ante twice as long to clean the house as it does to make dinner (4 hours vs. 2 hours), but Freedy can make dinners just as fast as he cleans houses (5 hours vs. 5 hours). If you both have 20 hours that you can work each week, Ante can clean 5 houses (20 hours/4 hours per house), or make 10 dinners (20 hours/2 hours per dinner), or split his time between the two activities. Freedy, on the other hand, can clean 4 houses (20 hours/5 hours per house), or make 4 dinners (20 hours/5 hours per dinner), or split his time between the two activities."

Suttle continued, "Because Ante's dinner cost of clean houses is 2 (4 hours per clean house/2 hours per dinner), whereas Freedy's dinner cost of clean houses is 1 (5 hours per clean house/5 hours per dinner), Freedy is comparatively, or relatively, more efficient at cleaning houses than Ante. Comparative advantage dictates that Freedy should produce 4 clean houses in his 20 hours but he would sell house-cleaning services to Ante in return for dinners. Ante would, in turn, specialize in making dinners but would sell some dinners to Freedy for clean houses. For example, you two might agree that 1 cleaning of the house should cost 1.5 dinners. Freedy could sell Ante 2 house cleanings for 3 dinners:

$$3 \text{ dinners} = 2 \text{ house cleanings} \times 1.5 \text{ dinners per house cleaning}$$

"After trading, Freedy would have 2 clean houses and 3 dinners, which would have cost him 25 hours $(2 \text{ clean houses} \times 5 \text{ hours per clean house} + 3 \text{ dinners} \times 5 \text{ hours per dinner})$ to make if he had done it himself, but he worked only 20 hours. Ante would have 2 clean houses and 7 dinners, which would have cost him 22 hours (2 clean houses $\times$ 4 hours per clean house + 7 dinners $\times$ 2 hours per dinner) to make if he had done it himself, but he also only worked 20 hours."

"Therefore," concluded Suttle, "you're both better off by specializing in the production of the good that you are relatively efficient at producing and then engaging in trade. The secret is to produce the good in which you have a comparative advantage. Alternatively, you can remember that you should sell the good that is relatively inexpensive for you to produce. Trade is ultimately related to what the differences in relative prices would be if there were no trade. Does this help you understand swaps any better?"

Both brothers decided that spending a little more time thinking about the interest rates in the Goodweek–Bridgerock case might be useful.

Swapping Bond Proceeds and Coupon Rates with Quoted Swap Rates

We noted earlier that swaps have become standardized, with financial intermediaries quoting bid and offer rates on swaps for large amounts. Exhibit 21.10 demonstrates how currency swaps are done with a financial intermediary using quoted swap rates.

Exhibit 21.10 Swaps as Individual Transactions at Quoted Rates

GOODWEEK'S DOLLAR BOND ISSUE AND CASH FLOWS IN THE SWAP INTO EUROS WITH BANK CARRIBUS

	Dollar Bond Issue	Swap Receipts (+) and Payments (−) with Bank Carribus					
Year		**Notional $**	**Dollars**	**Notional €**	**Extra Dollar Interest**	**Extra Euro Interest**	**Effective Euro Cash Flows**
0	196.25	−200.00	−196.25	100.00			98.13
1	−17.00	16.50	17.00	−13.10	0.50	0.28	−13.38
2	−17.00	16.50	17.00	−13.10	0.50	0.28	−13.38
3	−17.00	16.50	17.00	−13.10	0.50	0.28	−13.38
4	−17.00	16.50	17.00	−13.10	0.50	0.28	−13.38
5	−217.00	216.50	217.00	−113.10	0.50	0.28	−113.38
AIC	8.98%	8.25%	8.98%	13.10%			13.93%

BRIDGEROCK'S EURO BOND ISSUE AND SWAP INTO DOLLARS WITH BANK CARRIBUS

	Euro Bond Issue	Swap Receipts (+) and Payments (−) with Bank Carribus					
Year		**Notional €**	**Euros**	**Notional $**	**Extra Euro Interest**	**Extra Dollar Interest**	**Effective Dollar Cash Flows**
0	97.75	−100.00	−97.75	200.00			195.50
1	−13.75	13.00	13.75	−16.70	0.75	1.33	−18.03
2	−13.75	13.00	13.75	−16.70	0.75	1.33	−18.03
3	−13.75	13.00	13.75	−16.70	0.75	1.33	−18.03
4	−13.75	13.00	13.75	−16.70	0.75	1.33	−18.03
5	−113.75	113.00	113.75	−216.70	0.75	1.33	−218.03
AIC	14.41%	13.00%	14.41%	8.35%			9.60%

BANK CARRIBUS'S CASH FLOWS

	Receipts (+) from Goodweek Payments (−) to Goodweek		Receipts (+) from Bridgerock Payments (−) to Bridgerock			
Year	**Dollars**	**Euros**	**Dollars**	**Euros**	**Dollars**	**Euros**
0	196.25	−98.13	−195.50	97.75	0.75	−0.38
1	−17.00	13.38	18.03	−13.75	1.03	−0.37
2	−17.00	13.38	18.03	−13.75	1.03	−0.37
3	−17.00	13.38	18.03	−13.75	1.03	−0.37
4	−17.00	13.38	18.03	−13.75	1.03	−0.37
5	−217.00	113.38	218.03	−113.75	1.03	−0.37
AIC	8.98%	13.93%	9.60%	14.41%		
				Present Value @	8.35%	13.00%
					4.84	−1.67
				Value in Dollars	1.50	

Note: All cash flows are in millions of dollars or euros.

We continue to illustrate the issues with Bank Carribus acting as the financial intermediary for Goodweek and Bridgerock. Now, though, each firm deals individually with Bank Carribus, starting from the bank's quoted swap rates. The end result is that Bank Carribus again has a positive net present value for the two transactions because it will systematically make payments in currencies at lower interest rates than the payments it receives from firms.

This example has aspects that are both more complex and simpler than the typical swap. The example is more complex because we require the financial intermediary to make the payments on actual bonds. Standard "plain-vanilla" swaps simply pay the quoted swap rates on an even notional amount, but no attempt is made to match the cash flows of an underlying bond issue. If the financial intermediary is required to match the cash flows of a bond, as we are doing in this case, the swap is considered to be "off market," and the additional cash flows required to match the bond payments must be valued somehow. Because the additional payments happen at different times in the future, the interest rates used for different periods may differ, depending on the time period at which the payments are made. The simplification we use in the example is that the interest rates are the same at all maturities.[2]

Suppose that Bank Carribus offers the following quotations on 5-year fixed interest rate and currency swaps for annual cash flows:

U.S. Dollars: 8.25% bid and 8.35% offered against the 1-year dollar LIBOR
Euros: 13.00% bid and 13.10% offered against the 1-year dollar LIBOR

Let's explore how the swaps would be done.

The Transactions of Goodweek

Consider how Goodweek interacts with Bank Carribus in a currency swap based on quoted swap rates. Goodweek issues the dollar bond, but it wants euro debt. Goodweek therefore asks Bank Carribus to make the interest and principal payments on its dollar bond issue. In return, Goodweek will make euro-denominated payments to Bank Carribus. If Bank Carribus is using the quoted swap rates, Bank Carribus is willing to make fixed dollar payments to Goodweek at an interest rate of 8.25%. For $200 million principal, Bank Carribus would expect to pay interest of

$$0.0825 \times \$200 \text{ million} = \$16.50 \text{ million}$$

Because the quoted interest rate at which Bank Carribus is willing to receive euro payments is 13.10%, and because the euro principal that is equivalent to $200 million is €100 million, the notional cash flows for Goodweek involve interest of

$$0.1310 \times €100 \text{ million} = €13.10 \text{ million}$$

However, this plain-vanilla swap does not suit Goodweek for two reasons. First, Goodweek does not have $200 million to exchange because it raised only $196.25 million in bond proceeds. Second, Goodweek must pay $17 million in annual interest to its bondholders, and Goodweek would like to receive that much from Bank Carribus.

Consequently, the actual swap requires two adjustments. First, in exchange for the $196.25 million proceeds of the bond issue, Bank Carribus gives Goodweek the equivalent value in euros at the exchange rate of $2/€:

$$\$196.25 \text{ million}/(\$2/€) = €98.13 \text{ million}$$

Second, Goodweek would like to have Bank Carribus pay it the full dollar interest on its bonds, which is more dollar interest than Bank Carribus is quoting on the swap, in exchange for which Goodweek will pay extra euro interest to Bank Carribus. This requires a **basis point adjustment** on the swap.

The extra dollar interest that Bank Carribus must pay to Goodweek is $0.50 million for each of the next 5 years. The present value of this amount at 8.25% is $1.98 million.[3] In order to find the extra euro interest that Goodweek must pay each year, we convert the present value of the extra dollar interest into euros at the spot exchange rate. Thus, we get a euro principal of

$$\$1.98 \text{ million}/(\$2/€) = €0.99 \text{ million}$$

[2]The financial intermediary would use the appropriate zero-coupon interest rates for different maturities to value the future cash flows. In general, zero-coupon interest rates for different maturities are not the same. In the swap market, traders derive zero-coupon interest rates from the swap rates, and it is this term structure, or "swap curve," that they use to value cash flows.
[3]The assumption of a flat term structure of interest rates is important in taking this present value with the 5-year rate as this cash flow pattern is quite different from a standard 5-year bond.

We now want to find the value of the annual euro payment that is equivalent to this euro principal, using the euro interest rate of 13.10%. It turns out that the present value of five payments of €0.28 million when discounted at 13.10% is equivalent to €0.99 million. Hence, the euro discounted present value of five payments of €0.28 million at 13.10% is equivalent to five payments of $0.50 million discounted at 8.25% when the exchange rate is $2/€. This extra euro interest is added to the €13.10 million of notional interest, and Goodweek will owe interest of €13.38 million. This provides Goodweek with an AIC of 13.93%, which is less than its direct euro borrowing cost of 14.16%.

The Transactions of Bridgerock

The transactions of Bridgerock's swap with Bank Carribus would be structured in an analogous way. Bridgerock wants dollar debt, but it issues a euro bond. Bridgerock asks Bank Carribus to make the interest and principal payments on its euro bond issue in return for letting the company make dollar-denominated interest and principal payments to the bank.

Because Bank Carribus is using the quoted interest rates, Bank Carribus would be willing to make fixed euro payments to Bridgerock at an interest rate of 13.00%. For €100 million principal, Bank Carribus would expect to pay interest of

$$0.13 \times €100 \text{ million} = €13 \text{ million}$$

Because the quoted interest rate at which Bank Carribus is willing to receive dollar payments is 8.35%, and because the dollar principal that is equivalent to €100 million is $200 million, the notional cash flows for Bridgerock involve interest of

$$0.0835 \times \$200 \text{ million} = \$16.70 \text{ million}$$

Once again, this plain-vanilla swap does not suit Bridgerock for two reasons. First, Bridgerock does not have €100 million to exchange because it raised only €97.75 million in bond proceeds. Second, Bridgerock must pay €13.75 million in annual interest to its bondholders, and Bridgerock would like to receive that much from Bank Carribus.

Consequently, the actual swap requires two adjustments: a change in the initial principals and a basis point adjustment. First, in exchange for the €97.75 million proceeds of the bond issue, Bank Carribus will give Bridgerock the equivalent value in dollars, at the exchange rate of $2/€:

$$€97.75 \text{ million} \times (\$2/€) = \$195.50 \text{ million}$$

Second, Bridgerock will require Bank Carribus to pay extra euro interest, in exchange for which Bridgerock will pay extra dollar interest to Bank Carribus. The extra euro interest that Bank Carribus must pay to Bridgerock is €0.75 million for each of the next 5 years. The present value of this amount at 13% is €2.64 million. In order to find the extra dollar interest that Bridgerock must pay each year, we convert the present value of the extra euro interest to dollars at the spot exchange rate. Thus, we get a dollar principal of

$$€2.64 \text{ million} \times (\$2/€) = \$5.28 \text{ million}$$

It turns out that the present value of five payments of $1.33 million when discounted at the dollar interest rate of 8.35% is equivalent to $5.28 million. These payments are, in turn, equivalent to five payments of €0.75 million discounted at 13% when the exchange rate is $2/€. This extra dollar interest is added to the $16.70 million of notional interest, and we find that Bridgerock will owe interest of $18.03 million. This provides Bridgerock with an AIC of 9.60%, which is less than its direct dollar borrowing cost of 9.99%.

The Transactions of Bank Carribus

The last part of Exhibit 21.10 provides the actual dollar and euro cash flows for Bank Carribus from engaging in the two swaps. At the beginning of the currency swap, Bank Carribus exchanges principal amounts that are equivalent at the spot exchange rate. The net inflow of dollars to Bank Carribus is \$0.75 million, which is equivalent to its net outflow of euros, €0.38 million.

In years 1 through 5, Bank Carribus makes interest payments in dollars to Goodweek of \$17 million and receives dollar interest payments from Bridgerock of \$18.03 million, giving it a net dollar inflow of \$1.03 million. Bank Carribus also makes interest payments in euros to Bridgerock of €13.75 million and receives euro interest payments from Goodweek of €13.38 million, giving it a net euro outflow of €0.37 million. In the fifth year, the exchange of principals occurs with each firm, but Bank Carribus has no net cash flows of either dollars or euros because the principal amounts are equal.

Because Bank Carribus is not attempting to perfectly match the future cash flows of two counterparties, it bears some risk from these two transactions due to possible fluctuations in interest rates and exchange rates. Without knowing Bank Carribus's overall portfolio of cash flows, though, we cannot know whether Bank Carribus is taking on additional risk. Since it is making a market in these transactions, it is only concerned about the net exposure it generates from all the transactions it makes.

Because Bank Carribus now experiences dollar and euro cash flows in all 5 years instead of just in the present, we must take the present values of the future cash flows to determine how much net revenue Bank Carribus has generated in the two transactions. The present value of the dollar cash inflow can be taken at the swap rate of 8.35%, because this is the swap rate at which the bank receives dollars. The dollar present value is \$4.84 million. The euro cash outflow from Bank Carribus is discounted at 13%, which is the rate at which Bank Carribus pays euros. The euro present value is €1.67 million. The net of these two cash flows in dollars is

$$\$4.84 \text{ million} - [(\$2/€) \times €1.67 \text{ million}] = \$1.50 \text{ million}$$

Currency Swaps as a Package of Forward Contracts

In the 5-year swap just described, Goodweek contracts to pay euros in return for receiving dollars at various dates in the future. Bridgerock is paying dollars in return for receiving euros at various contractual dates in the future. These transactions are analogous to long-term forward contracts. Goodweek's transactions define bid prices of dollars per euro from Bank Carribus's perspective, and Bridgerock's transactions define ask prices of dollars per euro, again from the perspective of the financial intermediary.

Notice, though, that the structure of the 5-year swap has four exchanges of currencies at the same implicit forward exchange rate and a fifth exchange at a different rate. That is, the exchanges of the five interest payments are done at the same implicit forward rate, and the final return of principal is done at the original spot rate. When interest rates differ across currencies, the implicit forward rates in the swap are very different from the long-term forward rates that we have calculated in earlier chapters using the spot exchange rate and the term structures of spot interest rates. To understand the difference and to get an idea why the long-term swap market exits, let's examine how Goodweek and Bridgerock might go about hedging their transactions in the forward market.

Euro Bond Issues with Forward Hedging

Rather than doing currency swaps, both Goodweek and Bridgerock could exploit their comparative advantages in borrowing and achieve the desired currencies of denomination for their liabilities by issuing bonds in their comparatively low-cost currencies and using long-term forward contracts to hedge the bond payments. In this scenario, Goodweek issues dollar bonds and contracts to buy dollars with euros in the long-term forward market to cover the dollar interest and principal payments owed to its bondholders. Goodweek would offset its outstanding dollar liability with the forward-market contracts of a financial intermediary, like Bank Carribus, which promises to deliver dollars to Goodweek in return for the company making euro payments to the bank. Analogously, Bridgerock would issue euro bonds and contract to sell dollars forward for euros in the long-term forward market to cover its euro interest and principal payments. Bridgerock matches its euro liabilities with a sequence of euro assets that Bank Carribus delivers to the company in return for the company making dollar payments to the bank.

If the currency swap is to be preferred by both Goodweek and Bridgerock, the transaction costs in the long-term forward market must exceed those in the currency swap market. Exhibit 21.11 presents a set of bid and ask forward exchange rates such that this is indeed the case. The midpoints of the bid and ask forward rates for year k in the future are determined from covered interest rate parity using the midpoints of the dollar and euro swap rates:

$$(\$2/€) \times (1.0830/1.1305)^k$$

This is the right computation because the term structure of interest rates is assumed to be flat. The higher euro interest rate results in a substantial forward dollar discount on the euro. The forward market transaction costs are given by the percentage bid–ask spreads in the % Spread column, and they increase with maturity.

In Exhibit 21.11, Goodweek issues the dollar bond and converts the \$196.25 million proceeds into €98.12 million at Bank Carribus's ask rate of \$2.0002/€ in the spot market. We use the ask rate because Goodweek is selling dollars to Bank Carribus for euros. In years 1 through 5, Goodweek buys dollars from Bank Carribus with euros, which gives Goodweek euro liabilities. These transactions are done at Bank Carribus's bid rates of dollars per euro. We use the bid rates because Goodweek is contracting to buy dollars forward from Bank Carribus with euros. For example, Goodweek's first-year euro payment is

$$€8.88 \text{ million} = \$17 \text{ million}/(\$1.9143/€)$$

Goodweek's resulting euro AIC for these transactions is 13.96%. This is slightly higher than the AIC of 13.93% achieved in the currency swap, so Goodweek would prefer the currency swap.

To use the forward market hedge, Bridgerock would issue the euro bond and convert the €97.75 million proceeds into \$195.48 million at Bank Carribus's bid rate of \$1.9998/€ in the spot market. In years 1 through 5, Bridgerock would contract to buy euros from Bank Carribus with dollars, which gives Bridgerock dollar liabilities. These transactions would be done at Bank Carribus's forward ask rates of dollars per euro. Bridgerock's resulting dollar

Exhibit 21.11 Bond Issues Hedged in the Forward Market

	Dollars/Euros				Goodweek's Dollar Bond Hedged into Euros		Bridgerock's Euro Bond Hedged into Dollars	
Year	**Bid**	**Midpoint**	**Ask**	**% Spread**	**Dollars**	**Euros**	**Euros**	**Dollars**
0	1.9998	2.0000	2.0002	0.02	196.25	98.12	97.75	195.48
1	1.9143	1.9160	1.9176	0.17	−17.00	−8.88	−13.75	−26.37
2	1.8316	1.8355	1.8393	0.42	−17.00	−9.28	−13.75	−25.29
3	1.7516	1.7583	1.7651	0.77	−17.00	−9.71	−13.75	−24.27
4	1.6742	1.6845	1.6947	1.22	−17.00	−10.15	−13.75	−23.30
5	1.5990	1.6137	1.6284	1.82	−217.00	−135.71	−113.75	−185.23
				AICs	8.98%	13.96%	14.41%	9.79%

Notes: Midpoint forward prices are $(\$2/€) \times (1.0830/1.1305)^k$, where k is the number of years in the future. Cash flows are in millions of dollars or euros. The % spread is $100 \times (\text{Ask} - \text{Bid})/[(\text{Ask} + \text{Bid})/2]$.

AIC for its euro bond issue hedged into dollars in the forward market is 9.79%, which is higher than the 9.60% achieved in the currency swap. Hence, Bridgerock would prefer the currency swap as well.

The Value of a Currency Swap

As explained earlier, currency swaps begin life as zero net present value contracts. Over time, though, as interest rates and exchange rates change, a currency swap develops a positive value to one of the counterparties, with a corresponding negative value to the other participant. Consider the perspective of Goodweek. It owes euro interest and principal to Bank Carribus and is receiving dollar interest and principal from Bank Carribus. Essentially, the currency swap gives Goodweek an asset in the form of a dollar bond with a principal of $200 million and coupons of 8.50% because it is receiving $17 million of interest; it gives Goodweek a liability in the form of a euro bond with a principal of €100 million and coupons of 13.38% because it is paying €13.38 million of interest.

Let $B(t, \$200\text{ m}, 8.50\%)$ and $B(t, €100\text{ m}, 13.38\%)$ represent the market prices of these dollar and euro bonds at some time, t, in the future, and let $S(t, \$/€)$ be the spot exchange rate. Then, the dollar market value of the currency swap, from Goodweek's perspective, is

$$B(t, \$200\text{ m}, 8.50\%) - [B(t, €100\text{ m}, 13.38\%) \times S(t, \$/€)]$$

The market value of the swap is affected by three things. It rises if the dollar strengthens relative to the euro because the dollar value of Goodweek's euro liability falls. The swap also increases in value if dollar interest rates fall or if the euro interest rates rise because these interest rate changes directly affect the present values of the fixed cash flows in the swap.

Bridgerock's perspective is the opposite of Goodweek's. Bridgerock owes dollar interest and principal, and it is receiving euro interest and principal. The currency swap consequently gives Bridgerock an asset in the form of a euro bond with principal of €100 million and coupons of 13.75% because Bridgerock receives €13.75 million of interest; the swap gives Bridgerock a liability in the form of a dollar bond with principal of $200 million and coupons of 9.015% because it pays interest of $18.03 million. If $B(t, \$200\text{ m}, 9.015\%)$ and $B(t, €100\text{ m}, 13.75\%)$ represent the market prices of these dollar and euro bonds at some future time, t, the euro market value of the currency swap, from Bridgerock's perspective, is

$$B(t, €100\text{ m}, 13.75\%) - [B(t, \$200\text{ m}, 9.015\%)/S(t, \$/€)]$$

This euro market value rises if the dollar weakens relative to the euro, if dollar interest rates rise, or if euro interest rates fall.

If either firm wants to exit the swap early, the market value of the swap determines which firm receives money. Exhibit 21.12 determines the market value of Bridgerock's swap if it decides to close out the swap after 1 year, with 4 years of interest and the final principal payment remaining. The spot exchange rate is $2.25/€, the dollar interest rate for 4-year bonds is 8%, and the euro interest rate for 4-year bonds is 12%. At these prices, the euro cash flows that Bridgerock is scheduled to receive have a present value of €105.32 million, which is greater than the face value because the euro interest rate has fallen. The dollar present value of what Bridgerock is required to pay has increased to $206.72 million because the dollar interest rate has also fallen. The net euro value of these cash flows at the spot rate is

$$€105.32\text{ million} - [\$206.72\text{ million}/(\$2.25/€)] = €13.44\text{ million}$$

If Bridgerock wanted to close out the swap, Bank Carribus would pay Bridgerock €13.44 million. Of course, Bridgerock would still owe its euro bondholders.

Exhibit 21.12 Valuing a Swap to Close Out the Position

BRIDGEROCK'S EURO BOND ISSUE AND SWAP INTO DOLLARS WITH BANK CARRIBUS

	Swap Receipts (+) and Payments (−) with Bank Carribus	
Year	**Euros**	**Dollars**
2	13.75	−18.03
3	13.75	−18.03
4	13.75	−18.03
5	113.75	−218.03
	105.32	−206.72
	PV © 12%	PV @ 8%
Euro value of the Swap at USD2.25/EUR	13.44	

Notes: The euros Bridgerock is to receive are discounted at 12%, the dollars Bridgerock is to pay are discounted at 8%, and the spot exchange rate is \$2.25/€.

Note that the changes in valuation that we have discussed ignore the issue of credit risk, which is critical in advanced valuation methodologies, as exemplified by the analysis of Duffie and Singleton (1997).

The Rationale for Currency Swaps

A currency swap is a low-transaction-cost instrument for changing the currency of denomination of debt financing. This by itself does not explain why the currency swap market has grown so rapidly. The growth of the currency swap market reflects and has contributed to the increased integration of the world's international financial system. No longer are corporations tied to the financial markets of their country of residence. They can issue bonds in any currency and swap into their desired currency at the lowest AIC.

In the early days of the currency swap market, swaps were often driven by regulatory restraints and tax arbitrage opportunities. In 1985, R.J. Reynolds Tobacco Company famously took over Nabisco, lowering its costs of funding substantially by exploiting certain regulatory restrictions on Japanese institutional investors. Swaps played an integral role in making the deal work.

Differences in the way credit risks are analyzed across countries and the associated differences in spreads over risk-free rates also continue to provide an opportunity for lowering the cost of debt using swaps. When comparative borrowing advantages exist, it makes sense for the parties to issue debt in their least expensive currencies and to enter into a swap if the debts are not in the currencies of denomination that they prefer. These comparative advantages arise because institutional differences across countries lead to debt pricing that is slightly different, depending on the ultimate holder of the debt and its currency of denomination. Such differences in credit spreads amount to a market inefficiency that can be exploited for profit.

Regulations on the types of debt instruments that institutions can hold and accounting and tax differences across countries also have contributed to the growth of the swap market by providing demands for certain types of bonds that borrowers might not otherwise want to issue. Financial intermediaries who understand these demands and know borrowers who can supply the debts are then in a position to do a swap that results in lower borrowing costs for the issuer and a profit for the financial intermediary.

Why Swaps and Not Forwards?

Although we explained how long-dated forward contracts can be used to convert bonds issued in one currency into bonds denominated in a preferred currency, this method of financing is not widely used because long-dated forward markets are relatively illiquid. The bid–ask spreads of long-dated outright forward contracts begin to widen beyond a maturity of 1 year.

Banks also like swaps because the associated cash flows are just like those of bonds, and they can easily hedge the swaps in the bond markets later. In other words, if the swap book has too many dollars coming into the bank at the 5-year maturity, the bank can simply sell a 5-year bond from its portfolio to balance that risk.

Because the cash flows of forward contracts are not like the cash flows of bonds, banks find it difficult to offset their exposures in long-term outright forward contracts with other business transactions. They consequently try to make the offsetting trade directly in the forward market with a different financial intermediary, which only pushes the problem onto someone else. If it is expensive for a bank to hedge a long-term forward contract, the costs will ultimately be pushed onto the demanders of the contracts, making them more expensive and therefore less popular.

21.4 Summary

This chapter examines interest rate, credit default, and currency swaps. The major points of the chapter are as follows:

1. The cash flows of swaps are structured like the cash flows of bonds. Banks act as market makers in interest rate and currency swap markets. The outstanding volume of swaps is in the trillions of dollars.
2. Precursors to currency swaps were parallel loans (simultaneous loans between an MNC and the subsidiary of another MNC in two countries) and back-to-back loans (two MNCs lending one another money in different currencies and then subsequently lending to their foreign subsidiaries within a single loan document).
3. The relatively new credit default swap is essentially an insurance contract between a protection buyer and a protection seller covering default on a specific bond or loan. Credit default swaps played a major role in the 2007 to 2010 global financial crisis, when default rates shot up.
4. Interest rate swaps allow a corporation or an institution to convert from fixed-rate debt to floating-rate debt or from floating-rate debt to fixed-rate debt, using a bank as an intermediary. No principal payments are made. The cash flows associated with interest rate swaps are based on the notional principal, which is the conceptual amount of the outstanding debt.
5. In a currency swap, the counterparties exchange principal amounts in two different currencies, and they agree to pay and receive interest on those currencies, as well as reverse the initial exchange of principal amounts at a fixed date in the future. The principal amounts are equivalent at the prevailing spot exchange rate.
6. Currency swaps can be used to exploit a company's comparative advantage in borrowing across countries and then swap into their preferred currencies of denomination.
7. Swap market transaction costs are lower than transaction costs in the long-term forward market because the structure of swaps allows banks to easily trade in the bond markets to hedge their exposures.

Questions

1. How does an interest rate swap work? In particular, what is the notional principal?
2. What is a currency swap? Describe the structure of and rationale for its cash flows.
3. What is a credit default swap? What happens in the event of default?
4. Banks quote interest rate and currency swaps using 6-month LIBOR as a basis for both transactions. How can a bank make money if it does not speculate on movements in either interest rates or exchange rates?
5. What is the AIC of a bond issue?
6. What is a comparative advantage in borrowing, and how could it arise?
7. What is basis point adjustment? Why is it not appropriate simply to add the basis point differential associated with the first currency to the quoted swap rate that the firm will pay?

8. Discuss the sense in which a 5-year currency swap is a sequence of long-term forward contracts. How do the implicit forward exchange rates in a currency swap differ from the long-term forward exchange rates for those maturities?
9. What are the determinants of the value of a currency swap as time evolves? Is it possible to close out a swap before it has reached maturity?

PROBLEMS

1. General Motors (GM) wants to swap out of \$15,000,000 of fixed interest rate debt and into floating interest rate debt for 3 years. Suppose the fixed interest rate is 8.625% and the floating rate is dollar LIBOR. What semiannual interest payments will GM receive, and what will GM pay?
2. Pfizer is a U.S. firm with considerable euro assets. It is considering entering into a currency swap involving \$10 million of its dollar debt for an equivalent amount of euro debt. Suppose the maturity of the swap is 8 years, and the interest rate on Pfizer's outstanding 8-year dollar debt is 11%. The interest rate on the euro debt is 9%. The current spot exchange rate is \$1.35/€. How could a swap be structured?
3. At the 7-year maturity, U.S. Treasury bonds' yield to maturity is 7.95% p.a. The Second Bank of Chicago states that it will make fixed interest rate payments on dollars at the yield on Treasury bonds plus 55 basis points in exchange for receiving dollar LIBOR, and it will receive fixed interest rate payments on dollars at the yield on Treasury bonds plus 60 basis points in exchange for paying dollar LIBOR. If you enter into an interest rate swap of \$10 million with Second Chicago, what will be your cash flows if you are paying the fixed rate and receiving the floating rate?
4. The swap desk at UBS is quoting the following rates on 5-year swaps versus 6-month dollar LIBOR:

   U.S. Dollars: 8.75% bid and 8.85% offered
   Swiss Francs: 5.25% bid and 5.35% offered

   You would like to swap out of Swiss franc debt with a principal of CHF25,000,000 and into fixed-rate dollar debt. At what rates will UBS handle the transaction? If the current exchange rate is CHF1.3/\$, what would the cash flows be?
5. Suppose Viacom can issue \$100,000,000 of debt at an AIC of 9.42%, whereas Gaz de France can issue \$100,000,000 of debt at an AIC of 10.11%. Suppose that the exchange rate is \$1.35/€. If Viacom issues euro-denominated bonds equivalent to \$100,000,000, its AIC will be 8.27%, whereas if Gaz de France issues such bonds, its all-in cost will be 9.17%. Which firm has a comparative advantage when borrowing euros? Why?
6. Suppose in problem 5 that because of currency risk, Viacom would prefer to have dollar debt, and Gaz de France would prefer to have euro debt. How could an investment bank structure a currency swap that would allow each of the firms to issue bonds denominated in the currency in which the firm has a comparative advantage while respecting the firms' preferences about currency risks?
7. Suppose Sony issues \$100,000,000 of 5-year dollar bonds. Nomura will handle the bond issue for a fee of 1.875%. Sony's bonds will be priced at par if they carry a coupon of 8.5%. As the swap trader for Mitsubishi UFJ (MUFJ), you have been quoting the following rates on 5-year swaps:

   U.S. Dollars: 8.00% bid and 8.10% offered against the 6-month dollar LIBOR
   Japanese Yen: 4.50% bid and 4.60% offered against the 6-month dollar LIBOR

   Sony would like to do the dollar bond issue, but it prefers to have fixed-rate yen debt. If MUFJ gets the proceeds of the dollar bond issue, giving Sony an equivalent amount of yen, and MUFJ agrees to make the dollar interest payments associated with Sony's dollar bonds, what yen interest payments should MUFJ charge Sony? What is Sony's all-in cost in yen? The current spot exchange rate is ¥98.50/\$.
8. Assume that 1 year has passed since you entered into the transaction described in problem 4. Assume that the new spot exchange rate is CHF1.45/\$ and that UBS is now quoting the following interest rates on 4-year swaps:

   U.S. Dollars: 7.50% bid and 7.60% offered against the 6-month dollar LIBOR

Swiss Francs: 6.75% bid and 6.85% offered against the 6-month dollar LIBOR

If you close out the swap in problem 4, what net dollar cash flow will you experience? Explain why this is the correct amount. You can assume that the term structures of interest rates in both currencies are flat.

9. Web Question: Go to www22.verizon.com/investor/app_resources/interactiveannual/2010/mda06.html to find an excerpt of the 2010 Annual Report of Verizon, a large telecommunications company. Determine whether they use interest rate and/or currency swaps and why.

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