A Primer on Currency Derivatives

*Gregory P. Hopper**

An American company wants to import new computer screens from Japan. Company executives discover that they can buy the computer screens at a price of 10,000 yen per screen. At the prevailing exchange rate of 100 yen per dollar, the screens will cost $100 each. Market research reveals that each computer screen can be sold for $105 in the United States, a profit of $5 per screen. Excited by this prospect, the company negotiates a contract to buy 1250 computer screens, yielding a profit of $6250. The company will take delivery of the screens in exactly one year, at which time payment will be due in full.

After one year, the company is shocked to learn that the exchange rate is no longer 100 yen per dollar, but 95 yen per dollar. Since the company must buy its yen at the exchange rate prevailing on the delivery date, each computer screen costs $105.26 (10,000 yen/screen divided by 95 yen/dollar = $105.26 per screen) at delivery. Not only did the company fail to receive its anticipated $5 per screen profit, it lost $.26 per screen.

Exchange rate uncertainty is a common problem in international trade. Exchange rates under the floating rate system in effect since 1973 have been very volatile, and it is not uncommon for exchange rates to fluctuate dramatically. How could this company have reduced the risk of losses produced by volatile exchange rates? It could have used currency

*Greg Hopper is an economist in the Research Department of the Philadelphia Fed.

derivatives, which would have reduced the currency risk faced by the corporation.

In this article, we'll look at the three major currency derivatives: options, forwards, and futures. Although these derivatives are used to reduce the risk in international trade, they can also be used to speculate in foreign exchange, a risky proposition that has received much media attention. A common misconception is that derivatives are inherently mysterious, highly risky, and complex. On the contrary, the basic ideas underlying derivatives are not difficult to understand; indeed, futures and options can be understood as combinations of the simplest derivative, the forward contract. Moreover, derivatives are not necessarily very risky and can be used to reduce the risk inherent in other investments.

A forward contract is an agreement to buy or sell a specific quantity of currency at a predetermined dollar price on a specific date in the future.

FORWARD CONTRACTS

One way for the company to lock in the exchange rate in one year is to enter into a forward contract.[1] A forward contract is an agreement to buy or sell a specific quantity of currency at a predetermined dollar price on a specific date in the future. The predetermined price is called the forward exchange rate. The forward exchange rate is set to a value such that no money is required up front to enter the contract.

For example, the forward exchange rate for delivery in one year might be 97 yen per dollar. Thus, the company could enter a one-year forward contract on 12.5 million yen (1250 screens at 10,000 yen per screen). No money is transferred until delivery. At delivery the company would be certain to receive an exchange rate of 97 yen per dollar, so that each screen would cost $103.09, thereby guaranteeing a profit of $1.91 per screen.

There are always two sides to every forward contract: the buyer of the foreign currency is "long" the forward contract, while the seller of the foreign currency is "short." Forward contracts are usually traded over standardized intervals: 30, 60, 90, or 180 days, or one year. For example, if an investor goes long a 30-day forward contract for 1 million yen at a forward price of 100 yen per dollar, 30 days later the investor is obligated to purchase 1 million yen for $10,000.

Forward contracts are made over the counter. Unlike an instrument traded on an exchange, an over-the-counter security is not bought or sold in any centralized location such as the New York Stock Exchange. Instead, a company that wishes to go long the yen will call up various banks to find one that will take the other side of the contract. Making contracts over the counter means it is possible to negotiate any interval for the forward contract and any amount of foreign currency to be exchanged, as long as one can find a willing counterparty.

The payoff to the forward contract can be positive or negative. Let's return to the ex-

[1] Another method the company might use is to immediately buy the yen it needs at an exchange rate of 100 yen per dollar. However, a relationship known as covered interest parity guarantees that buying the yen immediately and investing them in one-year interest-paying Japanese notes is equivalent to immediately entering a one-year forward contract and investing the dollars that would have been converted to yen in one-year interest-paying U.S. notes. Covered interest parity is generally agreed to hold in the foreign exchange market. For more on covered interest parity, see Grabbe (1991).

ample of a long one-year forward contract in yen with a forward price of 97 yen per dollar. Assume that the exchange rate when the contract comes due is 100 yen per dollar. In this case, the company suffers a loss, since the forward contract requires it to buy 97 yen for $1 when it could have obtained 100 yen per dollar at the prevailing exchange rate. On the other hand, if the exchange rate in one year turns out to be 95 yen per dollar, the company would make a profit, since the forward contract would allow it to exchange currency at 97 yen per dollar instead of the prevailing exchange rate of 95 yen per dollar.

This suggests a drawback to using forward contracts. Forwards reduce the risk of loss by locking in the future exchange rate. But if the exchange rate moves in a favorable way, the company can't receive the extra profit. For example, suppose we had the same contract described in the previous paragraph, but the exchange rate in one year turned out to be 105 yen per dollar. At 105 yen per dollar, the computer screens would cost $95.24, which involves an even larger profit for the company with respect to what it had anticipated. But the forward contract obligates the company to pay 97 yen per dollar, a cost of $103.09 per computer screen.

Another problem with forward contracts is that they involve potentially large credit risk, particularly to banks, which typically take the other side of the contract. Suppose that the company is long the yen at a forward price of 97 yen per dollar on a one-year contract, but in one year the exchange rate is 100 yen per dollar. Then the company takes a loss. If the company refuses to carry out its obligations to purchase the yen at a forward price of 97 yen per dollar—that is, it defaults on the forward contract—the bank will not receive its profit. To guard against this problem, banks will take the other side of a forward contract only if the bank is allowed to reduce the company's line of credit by the amount of the forward contract. If the company has no line of credit with the bank, the bank may require the company to deposit 5 percent of the amount of the forward contract as collateral.

FUTURES CONTRACTS

Another method the company might use to reduce the risk of foreign exchange volatility is to enter a futures contract. Futures contracts are similar to forward contracts in that both involve the promise to buy or sell currency at a specific price at a specific time in the future. The difference is that profits or losses from holding a futures contract are realized and paid out at the end of each day; in contrast, profits or losses from holding a forward contract are realized and transferred only when the contract expires.

As an example, suppose the company goes long one futures contract on 12.5 million yen, the standard contract size at the International Money Market of the Chicago Mercantile Exchange. At the end of the day, suppose the futures price of the yen has risen as well. The short side then must pay the long side a profit in dollars equal to the difference between the new futures price and the old futures price times 12.5 million yen. If the futures price had fallen, the long side would have had to pay the short side the difference between the old and new futures prices times 12.5 million yen. This process continues daily until the contract matures. Each day, the profit or loss per yen of the long party equals the current day's closing futures price minus the previous day's closing futures price.

To see the similarity between a forward and futures contract, suppose the company had entered into a forward contract on 12.5 million yen instead. If at the end of the day the market expected the price of the yen to be higher in the future, the company would expect to make a profit on its long forward position, but this profit could be realized only if the expectation turned out to be correct on the day the forward

contract matured. To receive the profit at the end of the day, the company would have to liquidate the forward contract and enter a new forward contract at a higher forward rate. The short side would then have to pay the company its profit.

This analysis suggests that futures prices are like forward prices and that futures contracts are similar to sequences of forward contracts. However, futures prices do not, in general, equal forward prices on the same quantity of currency for delivery on the same date. John Cox, Robert Ingersoll, and Steven Ross have shown that futures prices are the same as forward prices if we know with certainty what interest rates will be in the future. However, if interest rates have a random element, as we would expect in reality, futures prices must be different from forward prices, with the difference depending on whether futures prices tend to move with interest rates.

Futures contracts are similar to sequences of forward contracts.

For example, if futures prices tend to rise when interest rates are rising, a futures contract will be worth more than a forward contract, and thus the futures price must exceed the forward price. The mechanism is as follows: when futures prices are rising, interest rates are rising as well, so the profits from a long futures contract can be invested at higher-than-average interest rates; but when futures prices are falling, interest rates are also falling, so that the losses can be financed at lower-than-average interest rates. Thus, when futures prices move in the same direction as interest rates, futures prices are higher than forward prices.

Similarly, if futures prices move in the opposite direction from interest rates, futures prices are lower than forward prices. In reality, of course, interest rates do have a random element, but in practice the magnitude of the co-movement between futures prices and interest rates is small: empirically, futures prices are close to forward prices. Thus, futures contracts may approximately be thought of as sequences of forward contracts.

Since the futures contract is settled on a daily basis rather than when the contract matures, default risk is reduced. If the losing party defaults, the winning party's losses are limited to that day's profits. Default risk is also reduced because each side in the futures contract is required to post a performance bond called "margin." When the futures contract is settled at the end of the day, the losing party must transfer the profit from his margin account to the margin account of the winning party. If the losing party's margin consequently falls below a threshold level, the losing party must restore the margin account or have the contract terminated.[2]

Futures contracts, unlike forward contracts, are traded on organized exchanges. The exchange specifies the features of the contract, such as the quantity of foreign exchange and the time and manner of delivery of the foreign exchange, and makes rules governing the market participants. In the United States, foreign currency futures contracts are traded at the International Money Market of the Chicago Mercantile Exchange. (See *Two Exchanges.*)

How would the company in our example

[2]The discussion has been simplified for expository purposes. The winning and losing parties do not directly transfer funds to each other, but rather use a clearing corporation as an intermediary. The clearing corporation also guarantees both sides of the contract against default. For more institutional detail regarding currency futures markets, see Grabbe (1991).

Two Exchanges

The International Money Market (IMM) of the Chicago Mercantile Exchange

The Chicago Mercantile Exchange, known as "The Merc," was founded in 1919 as a nonprofit organization to facilitate the trading of spot and futures commodity contracts. Since its founding, the exchange has grown, periodically adding new commodities to trade: in 1962, frozen pork bellies were added; in 1966, contracts on live cattle began trading, to give cattle ranchers and distributors hedging opportunities. In 1987, the International Money Market, a division of the Merc, began offering foreign currency futures for seven currencies in standardized amounts, for delivery at standardized times. The exchange requires that no trading take place at prices between minimum price moves, called ticks, and may place maximum daily allowable price moves on some currencies. The exchange also sets margin requirements for brokers who are members of the exchange. The Merc is regulated by the Commodity Futures Trading Commission.

The Philadelphia Stock Exchange

Founded in 1790, the Philadelphia Stock Exchange, the oldest securities market in the United States, began trading options on the major foreign currencies in 1982.* Currency options are traded on standardized amounts equaling one-half the amount of currency corresponding to an IMM futures contract on the same currency. The exchange has also standardized the expiration dates of the options and the strike prices. Expiration dates are set to correspond to the expiration dates of futures contracts at the IMM. Currency options traded at the Philadelphia Stock Exchange are guaranteed by the Options Clearing Corporation, which acts as a clearinghouse for all options traded on U.S. securities exchanges.

*For a more detailed look at foreign currency options traded on the Philadelphia Stock Exchange, see Brian Gendreau, "New Markets in Foreign Currency Options," Federal Reserve Bank of Philadelphia *Business Review*, July/August 1984.

use a futures contract? The company can hedge its risk by buying one yen futures contract at the Chicago Exchange on the day the contract to purchase computer screens is signed. If the dollar price of the yen goes up from the initial exchange rate of 100 yen per dollar, the company pays more in dollar terms for the computer screens. However, the company profits from the futures contract, since the futures price will also rise. If the dollar price of the yen goes down, the company will lose money on the futures contract but will make up the loss with extra profits on the computer screens. Thus the company has hedged its risk and locked in the exchange rate of 100 yen per dollar.

The hedge may not be perfect, though, because the price on the futures contract may not move one-for-one with the exchange rate.[3] Thus, if the dollar-per-yen exchange rate rises and the company loses money, the futures price needs to rise just as fast for the profit on the futures contract to just counterbalance the loss from the computer screens. In general, this will not happen, and some portion of the company's yen risk will not be hedged.

If the company does not know the date of settlement, a futures contract is better than a forward contract. A forward contract requires the company to know the settlement day, but

[3]Futures rates are approximately equal to forward rates. Covered interest parity, mentioned in footnote 1, implies that the forward rate is determined by the exchange rate and the interest rates in both countries. Thus, the forward or futures rate will not in general move one-for-one with the exchange rate because interest rates in the two countries do not always move exactly together.

a futures contract is more flexible: the company can hedge its risk until settlement, then get out of the contract.

The disadvantage of the futures contract is that risk can't be perfectly hedged, since the futures price in general does not move exactly one-for-one with the exchange rate. Another difficulty with futures contracts is that the amount of foreign currency that a company might want to hedge will usually not equal the amount that can be hedged by a futures contract. For example, a company may need to hedge 20 million yen, but since it can hedge only 12.5 million yen per contract (the size of a standard contract on the IMM exchange), it will have to hedge 25 million yen with two contracts. A final disadvantage the futures contract shares with the forward contract is that it does not allow the company to benefit if the dollar price of the yen falls.

A *call option* on a currency allows the holder to buy that currency; a *put option* allows the holder to sell that currency.

CURRENCY OPTIONS

The final type of derivative the company might use is the currency option. A currency option gives its holder the right, but not the obligation, to take a position on a specific quantity of foreign currency at a prearranged price on or before the date the option expires.[4] The prearranged price is called the strike price, which is an exchange rate. For example, if the option were on yen, the strike price would be quoted in terms of dollars per yen. The date the option expires is called the expiration date. The premium is the price paid to acquire the option. A *call option* on a currency allows the holder to buy that currency; a *put option* allows the holder to sell that currency. The option holder is said to exercise the option when he invokes his right to buy or sell foreign currency at the strike price. Options are European or American. A European option can be exercised only on the expiration date, but an American option can be exercised on or before the expiration date.[5] In the United States, currency options on standardized amounts of foreign currency are traded at the Philadelphia Stock Exchange. (See *Two Exchanges*.)

The option will specify a quantity of foreign exchange to be bought or sold. For example, a call listed on the Philadelphia Stock Exchange would allow the holder to buy 6.25 million yen. But options need not be bought at exchanges. They can also be bought over the counter as long as the purchaser can find someone willing to sell an option.

A currency option is a kind of currency insurance: the option insures against unfavorable exchange rate movements, so that the maximum loss one can experience is the premium paid for the option. For example, suppose the American company buys two call options on 6.25 million yen, and the options expire in one year with a strike price of 97 yen per dollar, or \$.0103/yen. If the premium is \$.0001/yen, the company can't pay any more than \$.0104/yen (\$.0103/yen + \$.0001/yen = \$.0104/yen) when settlement is due. This means that each computer screen will cost no more than \$104, yielding a \$1 profit per screen.[6]

[4]For simplicity, we focus on options on foreign currencies with prices stated in terms of the dollar.

[5]In general, American options are traded more frequently than European options.

[6]For simplicity, the time value of money has been ignored in this calculation.

In contrast to a forward contract, the company can benefit from favorable movements in the exchange rate when using options. For example, suppose the exchange rate on the settlement date turned out to be 100 yen per dollar. In that case, the company will not exercise the option but will instead buy yen at the market rate. Thus, each computer screen will cost $100 plus the option premium of $1 per screen ($.0001/yen x 10,000 yen/screen), yielding a profit of $4 per screen.

Options have three basic benefits. First, using an option allows the company to profit from favorable exchange rate movements. However, the company must pay for this benefit by remitting the option premium. Second, the settlement date need not be known in advance. If the company signs a contract to purchase Japanese computer screens at some time in the future, the company can buy an American option with an expiration date after the latest date the computer screens could be bought. Since American options can be exercised on or before the expiration date, the company could exercise the option on the day that the computer screens are purchased.[7] Third, because options can be bought over the counter, a company can tailor an option to hedge exactly the amount of currency it desires.

Valuing Options. We have seen that a futures contract can be thought of as a combination of forward contracts. Options seem different, but they too can be thought of as forward contracts combined with borrowing or lending the domestic currency.

Consider a short period of time in which the exchange rate can be thought of as moving from its current value to one of two values at the end of the period. Of course, this is an approximation, but one that works well for short periods. If the exchange rate can take on only one of two values at the end of the period, the option can have one of two values, depending on which value the exchange rate turns out to have. These two payoffs over a short period can be replicated by a portfolio consisting of a long forward contract and riskless lending of the domestic currency. Thus, the option's value over this short interval must be the same as that of the replicating portfolio. Once an option is valued over a particular interval, the method can be extended to valuing an option over every interval by continually adjusting the forward rate-lending portfolio to match the payoffs of the option. This portfolio replication argument, discovered by Fischer Black and Myron Scholes and extended to the foreign exchange market by Mark Garman and Steven Kohlhagen, is used to calculate the fair value of an option: at each instant in time, the option must cost as much as a portfolio of forward contracts and lending of the domestic currency that exactly duplicates an option's payoffs. (See *Option Valuation.*)

USERS OF CURRENCY DERIVATIVES

The main users of currency derivatives are hedgers and speculators. Hedgers use currency derivatives to reduce the risk of international trade. Speculators use derivatives to increase substantially the potential return on their investments.

But the possibility of greater returns comes only by assuming greater risk. For example, suppose a speculator who wanted to invest in the Japanese yen could buy 12.5 million yen at 100 yen per dollar, which involves a dollar investment of $125,000. If the exchange rate moves to 95 yen per dollar, or $.0105/yen, in 30 days, the dollar value of this investment becomes $131,579, a monthly return of 5.3 percent. But if the exchange rate moves to 105 yen

[7]Since American options can be exercised on any day prior to and including the expiration date but the European option can be exercised only on the expiration date, an American option must be at least as valuable as a European option. Thus, American options cost at least as much as European options.

Option Valuation

Consider a European call on a hypothetical currency with a strike price of $5.50 and an expiration date one year from now. Each unit of the currency costs $5.50 today. The dollar interest rate is 10 percent per year. Forward contracts on the foreign currency with settlement in one year can be entered into today at a forward price of $5.72 per unit of foreign currency. Assume that the exchange rate in one year is not known with certainty, but the investor knows that it will be either $11 or $2.75 per unit of foreign currency. Then, if the investor lends $1.80 at 10 percent and enters a forward contract to purchase 2/3 of a unit of foreign currency at the end of the year, he will have duplicated the two possible option payoffs. Since $1.80 is the amount invested (recall that the forward contract costs nothing to enter), $1.80 must be the price of the option.

	Exchange Rate	
	S = $2.75	S = $11
Payoff to investing $1.80 cents at 10%	($1.80)(1.1)=$1.98	($1.80)(1.1)=$1.98
Payoff to entering forward contract to purchase 2/3 unit forward currency	(2/3)($2.75-$5.72)=-$1.98	(2/3)($11-$5.72)=$3.52
Total payoff from investing 180/11 cents and entering forward contract	$1.98 - $1.98 = 0	$1.98 + $3.52 = $5.50
Payoff to option	0	$5.50

In this hypothetical example, we assumed that we knew that the exchange rate will take on one of two values at the end of the year and found a portfolio to match the payoffs to the option. To use this idea to value options in general, we take a very short period, much less than one year, and assume that the exchange rate can take on one of two known values over that period. We may then apply the same hedging argument. As the period chosen becomes smaller and smaller, the assumption that the exchange rate will be one of two possibilities at the end of the period becomes a closer and closer approximation to the underlying dynamics of the exchange rate, provided that the up-and-down jumps are properly selected. For more on this method, termed binomial option pricing, see the paper by John Cox, Steve Ross, and Mark Rubinstein. As the period chosen becomes infinitesimally small, the binomial method converges to the Black-Scholes option-pricing technique.

per dollar, the speculator will lose part of his initial investment.

To gain leverage, the speculator might have bought 200 European call options that gave her the right to buy 1.25 billion yen for 97 yen per dollar, or $.0103/yen, in 30 days for a premium of $.0001/yen, or $125,000. If the exchange rate in 30 days turned out to be 95 yen per dollar, the speculator could buy 1.25 billion yen for $.0103/yen and sell them for $.0105/yen, yielding a profit of $250,000. Thus, the monthly return on this investment is 100 percent. Of course, this higher return comes with much greater risk. If the exchange rate happens to be above 97 yen per dollar on the option's expiration date, the speculator will not exercise the options and will lose the entire $125,000 investment.

RISKINESS OF DERIVATIVES

Some Option Risk Measures. Professional users of derivatives assess the risk of currency options by examining how the option price changes with respect to small changes in underlying variables, such as the exchange rate.[8] For example, consider a European call on the yen. Suppose the dollar price of the yen rises. Then, the price of the call will rise as well, since it is now more likely that the exchange rate will end up higher at the expiration date, and hence it is more likely that the call will ultimately be exercised at a profit. A number known as delta measures how much the call price changes for small changes in the exchange rate. If the delta of the European call is 0.5, the call price will rise half as fast as the exchange rate rises.

Delta is crucial to understanding option risk because it allows the user to think of an option's risk as being equivalent to the risk of holding the underlying currency itself. For example, consider a call on 6 million yen, which has a delta of 0.5. The dollar value of the option will change half as fast as the dollar value of 6 million yen, for small changes in the exchange rate. But this risk is equivalent to holding 3 million yen. Therefore, for small changes, we may think of the dollar risk of holding a call option on 6 million yen with a delta of 0.5 as being the same as holding 3 million yen directly.

Delta is not constant: it changes when the underlying exchange rate changes. Thus, delta is valid only for small exchange-rate changes. To assess how delta changes, users often calculate another number called gamma, which measures how rapidly delta changes when the exchange rate changes. Delta becomes a more realistic measurement of risk when gamma is small.

Option prices also rise when the volatility of the underlying exchange rate, which measures how widely the exchange rate fluctuates around its average value, rises. As the volatility of the exchange rate increases, the exchange rate is more likely to register high and low values with respect to the average value. Higher volatility increases an option's value because options benefit from extreme changes in the exchange rate in one direction but are not penalized by extreme changes in the other direction.

To understand how increasing volatility makes options more valuable, consider the case of a European call option and assume the volatility of the exchange rate equals some constant value. If the exchange rate ends up above the strike price at expiration, the option will be exercised at a profit. If the exchange rate ends up below the strike price, the option will not be exercised and will be worth nothing. Now increase the volatility. The higher volatility implies that the exchange rate is more likely to have higher and lower values than it did before the volatility increased. The higher values only increase the option's potential value, since the option may ultimately be exercised when the exchange rate is substan-

[8]For a more detailed presentation on measuring option risk, see Grabbe 1991).

tially above the strike price. But, at the same time, lower values of the exchange rate don't reduce the option's value, since the option cannot be worth less than nothing. Thus, higher volatility increases the option's upside potential without adding to its downside potential. Higher volatility, then, must increase a European call's value. Since this reasoning may be applied to European puts and American puts and calls, higher volatility of the underlying currency raises option prices in general.

Since an option's value increases when volatility rises and decreases when volatility falls, changing volatility of the underlying currency is an additional source of option risk. To assess this risk, users calculate a number called vega, which measures the sensitivity of an option price to small changes in the volatility of the underlying exchange rate.[9]

Correlation Risk. Derivative risk may also arise from the breakdown of assumed correlations between currencies. For example, suppose a company owns Spanish pesetas but is concerned that the dollar value of the pesetas could decline if the dollar-peseta exchange rate declines. Suppose the company would like to hedge this risk by using futures contracts, but no peseta futures contracts are available. Therefore, the company decides to use deutschemark (DM) futures. Clearly, the efficacy of this strategy depends on a stable correlation between the peseta and the deutschemark. If the peseta and the deutschemark tended to move one for one in the past and are expected to continue to do so in the future, the company could hedge its peseta exposure by selling DM futures. If the dollar price of the peseta falls, the company will lose money on the pesetas, but that loss will be made up by gains in the DM futures. However, this expectation that the two currencies will continue to move one for one may not, in fact, be realized, introducing risk to this hedge. Suppose, for example, that the deutschemark and the peseta start moving in opposite directions. Then the company will be unhedged and may experience more losses than it would have, had it not sold DM futures.

Speculation Risk. Speculation risk arises when a company combines a hedge with speculation, i.e., conjecturing about the likely future values of currencies. This problem most often arises when companies use exotic options (see *Simple Exotic Derivatives*), but it may be present in any derivative investment. An exotic option is a derivative that gives a company either more or less protection against exchange rate risk with respect to the simple options mentioned in this review. The greater protection must be paid for by remitting a higher premium, but less protection requires a lower premium than would be paid for a standard option.

When a company decides to use a derivative that provides less protection against exchange rate risk, it may be implicitly speculating that the exchange rate scenarios it is not insuring against are unlikely to happen.[10] It is thus bearing the risk that these scenarios might happen in exchange for the payment of a lower premium. This calculation may well be a sensible one for the company to make, but the company should understand the risks it is taking and the potential for losses.

Understanding the risks may well be more difficult in the case of exotic options, since they tend to be derivatives tailor-made to a company's particular situation and thus quite complex. It is important for a company to

[9]This risk measure is sometimes called kappa or lambda.

[10]The use of an exotic derivative doesn't necessarily combine hedging and speculation. As noted, the company may receive more exchange rate risk protection from an exotic option. And if the exotic option provides less protection, the company may not be implicitly speculating: the company's particular situation may not require full exchange-rate risk insurance.

Simple Exotic Derivatives

Cacall - A cacall is an option to purchase a call. Suppose a company might enter into a contract involving foreign exchange risk. Since the company might need a call option, it might want to hedge the risk that the option will become more expensive. The company can lock in the call's price by purchasing a cacall.

Caput - A caput is an option to purchase a put.

Contingent Premium Call - A contingent premium call is like a standard call except no premium is paid up front. Rather, if the exchange rate at expiration is above the strike price, so that the call has a positive value, a premium is paid at that time; but if the exchange rate finishes below the strike price, no premium is required. In our example in the text, if the company feels that the exchange rate is unlikely to move in such a way as to destroy the profit on the computer screens, it may purchase a contingent premium option. If the company's expectations are proven correct, it does not pay any premium for an option it did not need. But if the company's expectations are proven incorrect, and it needs to exercise the option, it will have to pay a higher premium than it otherwise would have paid to purchase a standard option.

Average Rate Option - An average rate option pays off the difference between the strike price and the average exchange rate over the life of the option. Suppose a company had sales of 1 million yen daily, and each day converted the yen to dollars at the prevailing exchange rate. Then the total dollars earned will equal 1 million times the number of days times the average exchange rate. Since the average exchange rate is not known in advance, the total dollar revenues are not known either. To hedge this risk, the company might purchase an average rate option.

Barrier Option - A barrier option comes into existence or is canceled depending on whether the exchange rate crosses a predefined barrier. For example, a down-and-out call is canceled if the value of the foreign currency declines below a certain level. This type of option is useful when a company believes that if the foreign currency declines below a certain level, the currency is unlikely to rebound to a point that will cause the company losses.

understand how an exotic derivative's value varies with exchange rates, interest rates, volatility, and other variables, and whether very large losses are possible under some circumstances. One method a company may use to help it understand these risks is to develop the capability to value exotic derivatives in-house so that the derivative seller's claims can be verified. The company may want to "stress test" the derivatives, i.e., examine how the derivatives' value changes for plausible and not-so-plausible changes in the economic environment. The stress test may reveal the potential for substantial losses for some particular small changes in the economic environment, especially if the hedging strategy involves a portfolio of exotic derivatives.

SUMMARY

The three major types of currency derivatives are the forward, future, and option. The future and the option can be understood in terms of the most basic derivative, the forward contract. Currency derivatives can be used to hedge risk as well as to speculate on exchange-rate movements. Exotic derivatives, by allowing less exchange rate protection in exchange for a lower premium, give a company the ability to combine hedging and speculation. However, the risk of exotic derivatives is more

difficult to understand. To alleviate this problem, a company could develop the means to value derivative contracts in-house and stress test them. When evaluating derivatives' risks, derivative users should also consider correlation risk. In general, derivatives add value to the marketplace, provided they are well understood and used properly.

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