

## Foreign Exchange Options: The Leading Hedge

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Foreign exchange options (FXOs) can serve international financial managers in several ways. First, FXOs are essential to hedging "contingent" foreign exchange exposures—the kind of exposure which arises, for example, when a U.S. contractor bids for a contract denominated in a foreign currency. Second, FXOs are used in active foreign exchange exposure management—that is, those cases in which management chooses to take a position on the direction or the volatility of currency movements. In this more speculative use, options can limit downside risk while retaining upside potential for profit. Forwards or futures, by contrast, do not allow the investor to take a view and cap losses at the same time. Third, using FXOs in portfolio management allows managers to construct portfolios according to the specific risk-return profile they desire. Conventional financial instruments allow managers to make tradeoffs only between the risk (or variance) and the return of a portfolio. FXOs, however, make possible the more complex trade-offs described later in this article.

### Hedging Contingent Exposures in Foreign Currency

Contingent foreign exchange exposures arise when there is the possibility, but not the certainty, of future receipts or payments in a foreign currency. This usually occurs, as mentioned above, when a bid is submitted for a contract denominated in a foreign currency. In such cases, the firm may wish to hedge its potential receivables at the time the bid is submitted.

To hedge contingent payables or receivables in foreign currencies, foreign exchange options can be used either alone or in combination with forward or futures contracts. Forward or futures contracts alone,

however, cannot be used to hedge contingent payables or receivables. In hedging contingent receivables, for example, the simple forward sale of foreign exchange (equal to the amount of the bid) is not a solution to the risk problem because the bidder's foreign currency exposure depends on whether the bid is eventually accepted. If the bid is accepted after the firm sells the foreign exchange forward, then the firm is indeed hedged. But if the bid is not accepted and the firm has already sold forward the anticipated amount of foreign currency, the firm has a "naked" short position in the foreign currency. It has taken a speculative rather than a hedged position; and if the foreign currency appreciates, the firm loses. But, if the firm does not sell forward the anticipated foreign currency and the bid is accepted, the firm finds itself in an uncovered long position. In this situation, it takes a loss if the foreign currency depreciates.

Contingent foreign exchange receivables also come about as the result of disposals of foreign subsidiaries, uncertain foreign sales, and uncertain dividend remittances from abroad, to name just a few possibilities. For example, the central banks of Portugal, Spain, Turkey, and Yugoslavia usually receive remittances from guest workers in Germany. These remittances depend on such factors as economic conditions in Germany, the prevailing exchange rate, the wedge between the prevailing official exchange rate and the parallel market rate, and so forth. These central banks also usually have debt-servicing liabilities denominated in dollars. They may need to hedge their contingent deutschemark receivables in terms of their certain dollar liabilities.

Options can solve these problems because the exercise of options is voluntary and contingent upon prevailing economic conditions. There are two basic

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methods of dealing with contingent receivables: (1) buy a put option on the foreign currency or (2) sell the foreign currency forward and simultaneously buy a call option. And, as can be demonstrated using the "option parity theorem," they are perfectly equivalent strategies.<sup>1</sup>

If using the first method, the purchase of a put option, one must buy the put such that the timing, quantity, and strike price of the option corresponds to that of the bid. If the timing of the receivable is uncertain even in the event the bid is won, then the bid should be hedged with American rather than European options. The maturity of the options should reflect the upper end of the uncertain timing range. The quantities and strike prices can take on a range of values depending on management's desired risk-return profile.

The premium on the put option is sometimes viewed as the cost of buying insurance against possible exchange rate fluctuations in the event the bid is accepted. If the bid is accepted and the foreign currency depreciates, the firm offsets the loss in the value of the foreign currency by exercising the put option. In fact, however, the put option also provides additional profit opportunities. If the foreign currency depreciates and the bid is rejected, the hedger can exercise the option and profit by selling the foreign exchange for dollars. (Of course, if the foreign currency appreciates, the firm will let the put option expire in either case.) In this sense, the option premium consists of both an investment value and a hedging value. Only the hedging value of the option premium should be incorporated into the cost of submitting the bid—provided, of course, that this hedging value can be calculated.

Using another, fully equivalent hedging strategy, the firm can sell the foreign currency forward, and simultaneously buy a call on the foreign currency, with matching quantities, exercise prices, and expiration dates.<sup>2</sup>

If the bid is accepted and the foreign currency depreciates, the forward transaction fully hedges the firm, which simply lets the call expire. In the event

that the foreign currency appreciates, the firm's forward contract covers its receipts, and it exercises the call for additional profits. If the bid is rejected, however, and the foreign currency appreciates, the call fully hedges the firm's short forward position. Should the foreign currency depreciate, the firm lets the call option expire and buys spot foreign currency to cover its forward position.

## Contingent Payables

Contingent payables in foreign exchange come about as the result of transactions such as stock tender offers, merger and acquisition tenders to foreign companies, pending foreign law suits, and probable foreign dividend payments. Such payables, like contingent receivables, are also properly hedged with foreign exchange options.

Once again, there are two equivalent techniques for hedging contingent payables in foreign exchange: (1) buy a call option on foreign exchange or (2) simultaneously buy a long forward contract on the foreign currency and a put option. To be fully hedged, it is assumed that the exercise price and the maturity of the option contracts match those of the corresponding forward contracts. However, as already noted, this need not always be the case.

If the contingent payable materializes, the long forward covers it. If the contingent payable does not materialize, the put covers the long forward position. As in the earlier hedging example, these two methods also allow for situations where additional profits are possible.

## Active Management of Foreign Exchange Exposure

Various option strategies can provide complex risk-return trade-off profiles that would not be available through other instruments. Among these are straddles and spreads.

1. According to the option parity theorem, buying a European call and selling a European put is equivalent to being long forward:  
buy call + sell put = long forward.

If the foreign currency appreciates relative to the exercise price, it is profitable to exercise the call. Conversely, if the foreign currency depreciates relative to the strike price, the buyer of the put exercises his option, forcing the seller of the put to buy the foreign exchange at the exercise price. Thus the simultaneous purchase of a call and sale of a put at the same exercise price is similar to the purchase of a forward contract at that exercise price. Note, however, that this equivalence is perfect only for European options which can be

exercised only at maturity, not before. The equivalence is not perfect for American options, which can be exercised before maturity and can hence result in a position in the foreign currency before the maturity of the forward contract.

Rearranging the terms above:

buy call + short forward = buy put.

Here, algebraically changing the sign of a term, when its position vis-a-vis the equal sign changes, is equivalent to transforming a long position to a short position, and conversely.

2. See note 1.

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## Straddles

A straddle is formed by simultaneously buying or selling puts and calls. The purchase of a straddle is equivalent to buying both a put and call at the same time; sale of a straddle is the same as simultaneously selling a put and call.

Straddles are bought or sold when management has specific expectations about the future variability of exchange rates, but not about the direction of those movements. Specifically, management buys a straddle when it believes a currency will either appreciate or depreciate beyond a specific point.<sup>3</sup>

Similarly, a straddle is sold if management thinks that currency movements will be limited within a specific range. For example, the firm may sell a straddle if it thinks that the volatility of the value of a certain currency will drop below market expectations, possibly because of expected central bank intervention. Conversely, the firm may buy a straddle if it expects volatility to rise above market expectations—as the result, say, of expected increases or decreases in money supply growth.

Figure 1c illustrates the profit opportunities provided by buying a straddle in the case of exchange rate movements below  $S_3$  and above  $S_4$ . To see why a straddle provides this payoff profile, remember that the purchase of a straddle is equivalent to the simultaneous purchase of a call option and a put option with identical terms. The profit profile of buying a call option at exercise price  $X$  is illustrated by Figure 1a. At spot exchange rates  $X$  and lower, the call is not exercised, so the loss equals the price of the option,  $c$ . At spot exchange rates above  $S_1$ , the option is sufficiently in the money to more than cover its cost. Between  $X$  and  $S_1$ , the option is in the money, though not by enough to cover its cost. Similarly, figure 1b illustrates the profit profile of buying a put option.

Return once more to Figure 1c, which, again, illustrates the profit profile of a straddle purchase. Since buying a straddle is the simultaneous purchase of a put and a call, figure 1c is the vertical sum of figures 1a and 1b. Buying a straddle, incidentally, should not be viewed as providing a "free lunch." The price of the straddle incorporates the market's assessment of the *variability* of the exchange rate.

The buyer of the straddle profits only if the exchange rate moves plus or minus a certain percentage,  $[(S-X)(100)/X]$ , or  $[(X-S)(100)/X]$ , beyond  $X$ . The seller of the straddle accepts that risk for a lump sum.

The profit profile of *selling* a straddle is the mirror image of figure 1c around the horizontal axis. An investor would write a straddle if he believed that the volatility of the currency would drop by more than the market expects, possibly as a result of expected central bank intervention to stabilize the exchange rate.

Just as in buying a straddle, writing a straddle does not imply a free lunch. Writing a straddle is quite risky because the investor is writing both a naked call and a naked put. He has no protection against large moves in the value of the currency in either direction, thus implying a potential for unlimited loss.

As figure 1 suggests, buying a straddle is equivalent to buying insurance, with a deductible, against large movements either up or down in the value of the underlying security. Profit opportunities or bargains exist, however, only if this insurance (1) can be bought for less than its fair actuarial value or (2) can be sold for more than its fair actuarial value.

The most important determinant of the fair actuarial value of this insurance is the expected volatility of the underlying currency. If one's expectation of this volatility is lower than the market's, one buys this insurance. But, if one's expectation of this volatility is lower than the market's, one sells this insurance. The side whose expectations are correct more often profits in the long run. So if someone thinks he can judge a currency's future volatility better than the market, he can buy or write straddles.

## Spreads

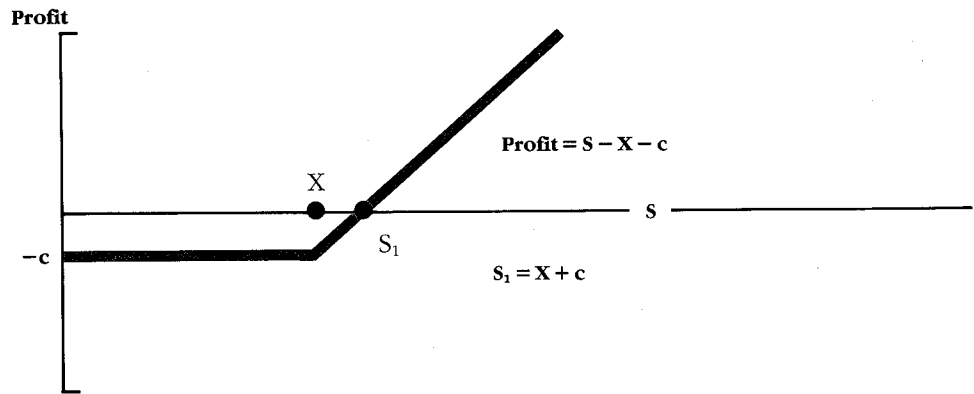
A spread is the simultaneous purchase of one option and sale of another on the same underlying security in which the two options differ only in time to expiration or in strike price. Vertical spreads are formed by varying only the strike price; horizontal spreads (also called "time" or "calendar" spreads) are formed by varying the time to maturity. These spreads are so named because options differing in exercise price are listed vertically in the published option quotations, and options differing in maturity

3. As shown below, this point is a function of the exercise prices of the individual options in the straddle, and the option premiums.

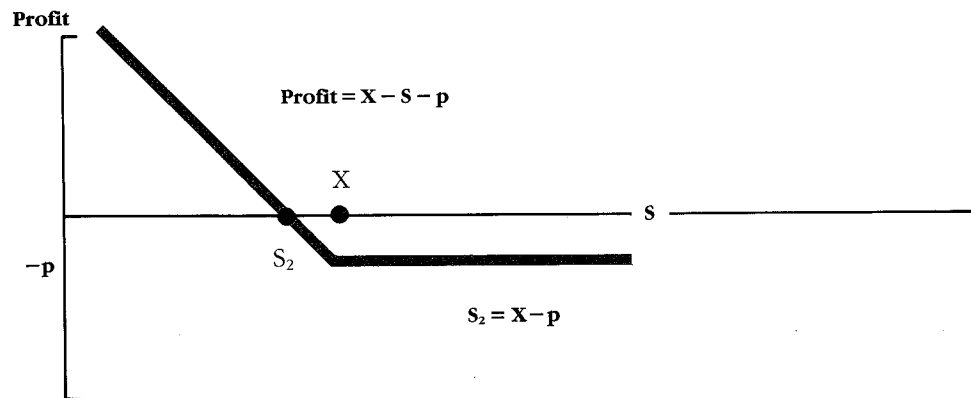
54 *Straddles are bought or sold when management has specific expectations about the future variability of exchange rates, but not about the direction of those movements.*

**FIGURE 1**  
**Profit Profile of Buying**  
**a Straddle**

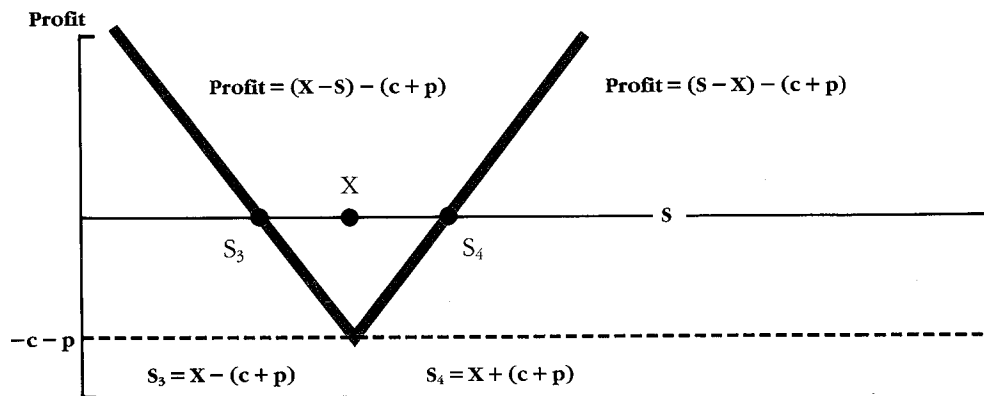
**(a) Buying a Call**



**(b) Buying a Put**



**(c) Buying a Straddle**

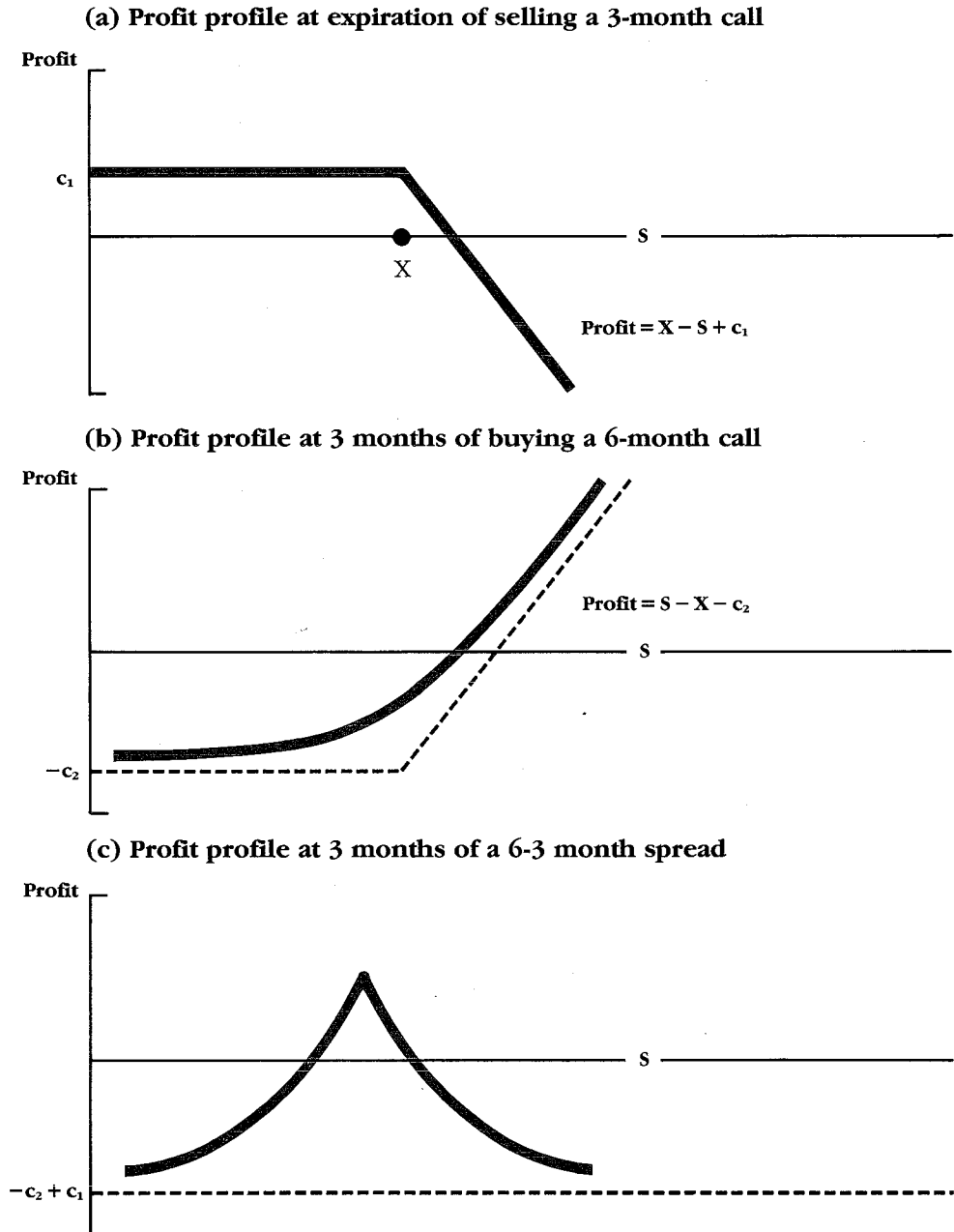


are listed horizontally.

When traders think that certain options are mispriced, they try to make a profit by establishing a spread—that is, by buying the low-priced option and

selling the high-priced one. The following example, using three-month and six-month foreign exchange options, illustrates how traders detect arbitrage opportunities.

**FIGURE 2**  
**Profit Profile of a 6-3**  
**Month Spread**



First, the implied variances of 3-month and 6-month FXOs are calculated by using the option pricing models together with current option prices to “back out” the market’s implicit estimate of expected variance. Second, the implied variance of 3-month FXOs is used to compute the theoretical value of 6-month FXOs. If the theoretical value of 6-month FXOs is higher than the actual value, then 6-month

FXOs must be underpriced and 3-month FXOs must be overpriced. Following the adage “buy low, sell high,” the trader buys 6-month FXOs and sells 3-month FXOs. The same trader could also arrive at the same result by comparing the implied variances of 3-month versus 6-month FXOs. The FXO with the higher implied variance is the one that is overpriced.

But this is not an entirely riskless activity. First,

**56** *If an international portfolio manager buys protective puts to cover his international investments, he can totally eliminate his downside risk at the expense of reducing his upside potential by the amount of the premium paid for the puts.*

minimal as it might be, a spread might incur a loss. The maximum loss is called the "basis" of the spread, and is discussed in further detail below. Second, variance may not be a stationary process—that is, the relationship between the variance of 3-month and 6-month FXOs may change over time—creating potential losses for those who use the past as their guide to speculating on the future.

### Horizontal Spreads

Figure 2 illustrates the profit of a horizontal spread formed by selling a 3-month call and by buying a 6-month call, both at the same exercise price. The profit profile, at expiration, of selling a 3-month is straightforward and is presented in part (a). The profit profile, at 3 months, of buying a 6-month call is given in part (b). (The broken lines are the asymptotes of the profit profile.) The solid line represents the actual profit profile, reflecting the fact that options command a time premium. The profit profile of the spread, at 3 months, is the vertical sum of parts (a) and (b). The maximum loss of the spread equals the premium of the 6-month call minus the premium of the 3-month call. This is called the "basis" of the spread.

### The Simple Vertical Spread

The simple vertical spread is formed by buying an option with one exercise price ( $X_1$ ) and selling another option with the same maturity date as the first, but at a different exercise price ( $X_2$ ). Figure 3 illustrates the profit profile of buying a call at  $X_1$ , and selling a call at  $X_2$  ( $X_2 > X_1$ ). The profit profile from selling a call at  $X_1$  and buying a call at  $X_2$  is the negative counterpart of figure 3.<sup>4</sup>

### The Butterfly Spread

This is formed by selling two options, one with a high exercise price and one with a low exercise, and buying two options at the exercise price in between the two. Figure 4 illustrates the profit profile of a butterfly spread formed by selling two calls at  $X_1$  and  $X_3$ , and by buying two calls at  $X_2$  [ $X_1 > X_2 > X_3$ ;  $X_2 = (X_1 + X_3) / 2$ ].

### The Sandwich Spread

A sandwich spread is the opposite of a butterfly spread. It is formed by buying two options, one with a high exercise price and one with a low exercise price, and selling two options at the exercise price in between the two. The profit profile of a sandwich spread formed by buying two calls at  $X_1$  and  $X_3$ , and selling two calls at  $X_2$  is the negative of figure 4 and is given in figure 5.

Note that the profit profiles of sandwich and butterfly spreads somewhat resemble those of straddles. The difference is that, unlike straddles, sandwich and butterfly spreads limit the potential profits and losses. Like straddles, sandwich and butterfly spreads can be used to take positions when one's expectation of the future volatility of a currency's change is different from that of the market's. The earlier economic arguments about the scarcity of free lunches also apply to butterfly and sandwich spreads.

### Other Spreads

In addition to the above, there is a wide variety of option strategies, including diagonal spreads (a combination of vertical and horizontal spreads) and others. Just as in the earlier strategies, these are used when the expectation about the currency's future volatility is different from the market's or when it is believed that a particular option is mispriced.

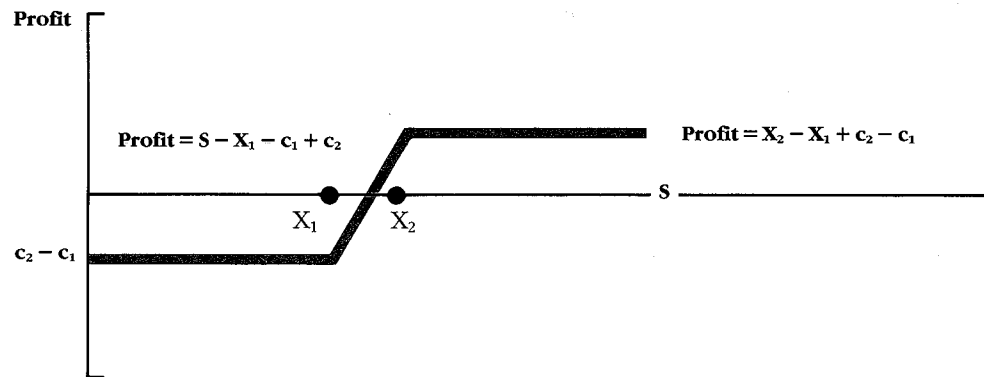
### The Use of Options in Portfolio Management

Modern portfolio theory holds that the performance of a portfolio of assets can be characterized by two variables: risk and return. It is possible to increase the expected return of a portfolio by accepting more risk and to reduce the risk of a portfolio by accepting lower expected return. The traditional technique of leveraging a portfolio up or down (by using forwards markets, for example) yields a trade-off between risk and return.

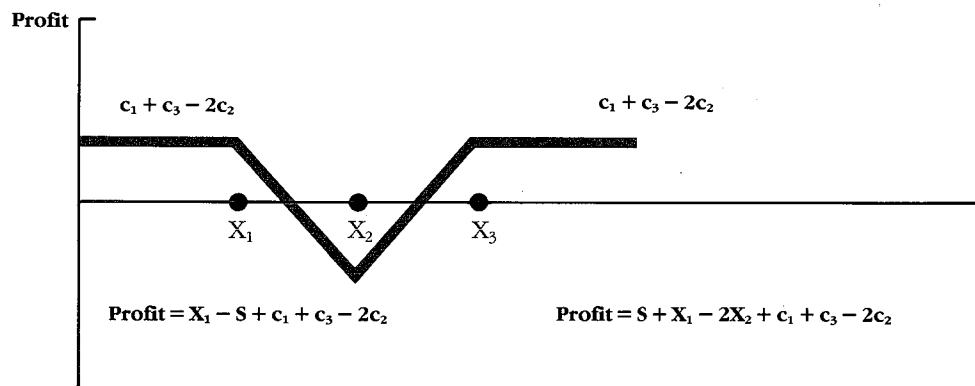
So, if an international portfolio manager completely covers all of his foreign exchange posi-

4. When referring to spreads, the first quantity represents the option that one is long in.

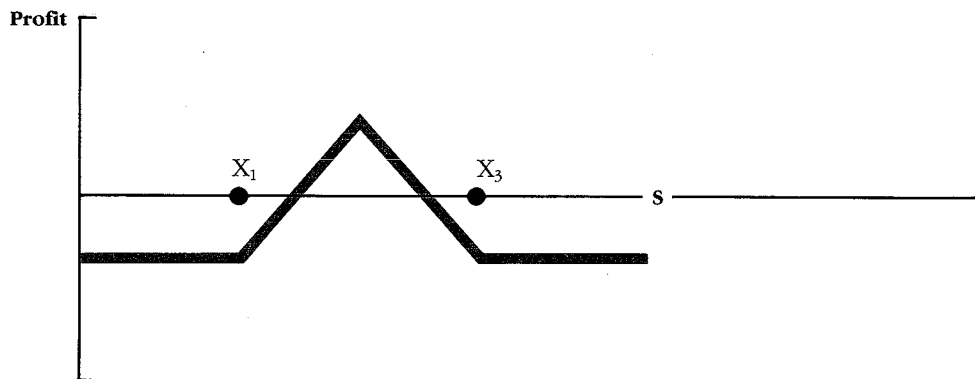
**FIGURE 3**  
Profit Profile of a  
Simple ( $X_1 - X_2$ )  
Vertical Spread



**FIGURE 4**  
Profit Profile of a  
Butterfly Spread



**FIGURE 5**  
Profit Profile of a  
Sandwich Spread



tions by buying forwards or futures contracts, he locks in his expected return, and eliminates his downside risk at the expense of removing any upside potential. Similarly, an international portfolio manager can choose to be only partially covered, reducing both the mean and the variance of the portfolio.

Options, however, open the door to other trade-offs. For example, if an international portfolio manager buys protective puts to cover his international investments, he can totally eliminate his downside risk at the expense of reducing his upside potential by the amount of the premium paid for the puts.

## Partially Hedging Payables or Receivables

Consider the case of U.S. domestic exporters who hold contracts for future delivery to a foreign country in the currency of that country. These exporters know that while their manufacturing costs are largely denominated in dollars, a selling price quoted in a foreign currency may fetch fewer (or more) dollars at delivery than when the contract was written. Similarly, American importers of foreign goods, with contracts for future delivery quoted in a foreign currency, face the possibility of a future change in their costs due to exchange rate fluctuations.

Of course, the exporter or importer can sit back and do nothing, accepting whatever exchange rate prevails at the time of delivery. Doing nothing, however, can mean large losses for the exporter if the foreign currency depreciates (or large gains if the currency appreciates). Many firms therefore seek to protect themselves from foreign exchange risk by selling all of the foreign exchange receivables forward. Doing so, however, means placing a ceiling on the exporter's profit. Alternatively, the exporter could buy puts on the foreign exchange. This procedure would allow the exporter to ensure minimum profits while retaining the possibility of larger profits. Similarly, an American importer of foreign goods, holding contracts for future delivery in a foreign currency, also could do nothing, go long in the forwards, or buy call options on foreign exchange. Of these alternatives, foreign exchange options may well be the best strategy for tailoring portfolios according to individual preferences and beliefs.

## Buying Calls and Puts for Active Portfolio Management

Some finance theorists have recently suggested that it may be profitable to bet against the forward rate. They argue that current exchange rates forecast future spot rates more accurately than do forward

rates, and that it is thus profitable to bet against the forward rate based on the current spot rate. The problem with this strategy is, of course, that it is quite risky.

To illustrate, suppose that the deutschemark (DM) is currently trading at \$0.54. If 3-month DMs are selling at \$0.55, this strategy dictates that one should go short in forward DMs. If, as indicated by the strategy, the DM ends up very close to \$0.54 in the future, then one makes a profit of \$.01 per DM. However, if the future spot price of the DM ends up above \$0.55, then one incurs a loss. Conversely, if spot pound is selling at \$1.61 and forward pounds are selling at \$1.60, then one goes long on forward pounds, expecting a profit of \$.01 per pound. The risk is again substantial, and losses result if the future spot price falls below \$1.60.

Options, however, limit the downside risk, allowing the active manager to take a view. Put differently, if the forward DM is at \$0.55, one goes short in DMs and simultaneously purchases a call for \$0.55, thereby putting a cap on losses. Conversely, if the forward pound is at \$1.60, then one goes long on forward pounds, simultaneously buying a put on pounds for \$1.60, thus putting a cap on losses.

This strategy is usually used in the context of a portfolio of currencies, because most currency movements are correlated. When returns on securities are correlated, using a number of securities in a portfolio allows risk/return profiles that are superior to the risk-return profile of a single security. When options are used in such a context, risk-return profiles can attain shapes that would otherwise be impossible.

## A Potent Instrument

Foreign exchange options, in sum, are a potent instrument for coping with today's highly volatile financial environment. Options enable managers to hedge contingent foreign exchange exposures, to take a view on the direction and volatility of exchange rate movements while limiting downside risk, and to tailor portfolio outcomes in new ways.

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