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Chapter 8

Speculations in the Foreign Exchange Market

INTRODUCTION

Speculation is an assumption of calculated risk expected to happen by an individual investor or a firm looking to make profits from future markets condition(s). Sometimes the investor takes a speculative market position without an underlying cover, which is called a *naked speculation.* If the expectations on the future unknown(s) are materialized, the investor makes the precalculated amount(s) of profit. Since expectations may prove incorrect, an investor sometimes or often tries to insure himself against financial fatality by way of holding some fallback positions. If the investor does speculate with such underlying protection, it becomes a *covered speculation.* In this chapter, an attempt is made to demonstrate how speculation yields profits to an investor in the foreign exchange markets with and without protective measures. In the following section, we present the analytical structure of naked speculation with and without transaction costs. In the section after that, we give an exposition of covered speculation with currency options and synthetic combinations thereof. In the last section, we make some concluding remarks.

NAKED SPECULATION

Investors are not alike. Some are risk averse and some are risk lovers. The risk-free investment strategies of a rational individual or institution in currency markets with spot and forward contracts with and without transaction costs are usually discussed under the rubric of arbitrage and hedging (see Ghosh, 1994). In this chapter, we attempt to explain the rational behavior of an economic agent, who chooses to assume risk in his investment strategies. Risk refers to an investor entering or plunging into uncertainty and unknown variables in the decision-making process in the expectation of generating positive rates of return. We confine our discussions here within the scope of operations in spot and forward markets in currency trading.

It is generally believed that in a financial world, the higher the risk one assumes, the higher the return one should expect in exchange. It is this general belief that drives an investor—individual or institution—into a choice of an investment menu with calculated risks. Empirical evidence often shows that an investor indeed does really well on the average in terms of returns by risky investment designs. We try to bring out the core of such risky investment, which is called *speculation*. Speculation, as already noted, is the act of assuming a calculated risk in expectation of higher rates of return on the invested amounts. The existing literature is replete with research pieces on speculation. Various aspects of this economic activity have been examined by the studies of Friedman (1953), Tsiang (1959), Grubel (1966), Kenen (1965), Spraos (1959), Neihans (1984), Feldstein (1968), Kohlhagen (1979), McKinnon (1979), and Wihlborg (1978), Ghosh (1997a, 1997b, 1998), and Ghosh and Arize (1993). Here, we plan to examine and explore the situations involving speculation for a rational investor in the currency markets. To do so, we first assume that the investor faces no transaction costs in his financial operations in the market. Later, we will move away from the assumption of no transaction costs in the calculation of rational speculation and profit measurement.

INVESTMENT STRATEGY WITH RISK

Forward Speculation and Spot Speculation without Transaction Costs

Consider the following data collected by an investor.

Current spot rate of exchange $S = 2.00$

One-year forward rate of exchange $F = 2.15$

One-year domestic rate of interest $r = 10\%$

One-year foreign rate of interest $r^* = 9.5\%$

Assume that the investor believes that spot rate of foreign exchange a year from the given day $\tilde{S}$ will be \$3.00 = £1. This belief may come from a phone call or fax transmittal from the investor's advisor, from a forecasting service, or simply from his own sense. Now, if the investor acts on this predicted value of the foreign exchange rate, he will enter into either forward speculation or spot speculation.

Forward Speculation without Transaction Costs

Forward speculation involves either the purchase or sale of forward contracts by the investor to enable him to earn profits by taking exactly the opposite position on the maturity date of the forward contract in the foreign exchange market. Spot speculation similarly involves the purchase or sale of foreign exchange in the current spot market with a view to making a profit in the future by taking exactly the opposite position. If, as we have already assumed, the *expected* spot rate of exchange one year from that day is 3, the investor can make a profit of \$3.00 − \$2.15 = \$0.85, *times* the value of the forward contract the investor now enters in. He simply buys pound sterling (the foreign currency in the example) at the rate of \$2.15 = £1 currently in the forward market—that is, he agrees to deliver \$2.15 for each British pound at the end of one year. On the settlement date of the agreed-upon forward contract, the investor gets a British pound for his \$2.15 to the counterparty, then he sells his just-acquired British pound at \$3.00 = £1. By doing so, that is, by buying the pound at the forward market on the spot and selling the pound at the future spot market at the then-spot rate, he makes a profit. If his forward contract size is £10,000,000, he makes a total profit of \$0.85H10,000,000 = \$8,500,000. If the future spot rate is predicted to be 1.20 (which is less than the forward rate of 2.15), the investor makes money by selling a forward contract on the pound. If he enters into a forward sale contract of British pound (that is, a forward purchase of U.S. dollars), he gets \$2.15 for the sale of each British pound, then he buys back the pound in the future spot rate of \$1.20 = £1. Effectively, the investor makes \$0.95 per pound. If his forward contract size is £10,000,000, he obviously makes a total profit of \$9,500,000. The rules are then as follows:

If $\tilde{S} > F$, buy foreign currency forward,
and total profit is = $(\tilde{S} - F).A_F$. (8.1)

If $\tilde{S}$ = F, buy or sell foreign currency forward,
and total profit is zero (= ($\tilde{S}$ 2 F).AF). (8.2)

If $\tilde{S} < F$, sell foreign currency forward,
and total profit is $(F - \tilde{S}).A_F$. (8.3)

Here A_F is the amount of the forward contract (contract size) in foreign currency denomination. Now, the question is: what happens if the prediction of on-the-spot rate a year from the given day becomes incorrect? From the illustration it is clear that as long as the spot rate one year from the given day is not less than one-year forward rate, the forward *buy* contract of the foreign currency will not yield loss to the investor, and similarly, as long as the spot rate one year from the given day is not more than a one-year forward rate, forward *sell* contract of the foreign currency will not yield loss to the investor. The situation beyond the dividing line then obvi-

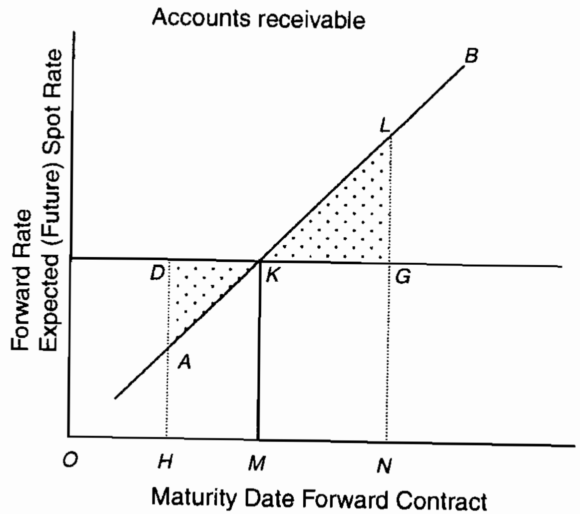

Figure 8.1 Profitable choice: forward buy or sell

ously creates loss for the speculator. Figure 8.1 portrays those results graphically.

Along the horizontal axis, we represent the forward contract maturity (settlement) date, and the vertical axis measures the forward rate and the spot rate of exchange on the date of forward contract maturity. In Figure 8.1, let *AKB* define the spot rate on the forward contract maturity date and *DKG* represent the forward rate of exchange. With this diagram, we exhibit the investor with a forward *buy* or *sell* contract of the foreign currency. If the contract maturity date is denoted by any point to the right of *M* (say, *N*) that corresponds to the spot rate above the forward rate (*NL* exceeds *NG*), he makes a profit on the forward *buy* contract (by *GL* times the amount of the contract size). If, on the other hand, the forward contract is a *sell* contract, and the maturity date of the forward is denoted by point to the left of *M* (say, *H*), he makes a profit to the tune of *AD* times the forward contract size. Exactly opposite happens, that is, loss is incurred by the investor, if at point *N*, he holds a forward *sell* contract, and at point *H*, he holds the forward *buy* contract. Since the investor does not have a crystal ball in his hand (and hence his prediction on future spot rate may prove significantly wrong), he may end up with a big loss for his speculative position with forward contract(s). In the situation of accounts payable, one gets exactly the opposite results.

Note now that forward speculation hardly involves any money being tied up until the settlement date arrives. It is a commitment (with probably a small percentage of the investor's line of credit attached to the contract). So, if the forward contract brings a fortune to the investor, he makes it virtually at the very instant he settles his forward contract and takes the opposite position in that instant spot market. The annualized rate of return in correct sense is more than finite.

Spot Speculation without Transaction Costs

Consider now the other alternative—spot speculation. In this case, the investor may choose to buy (or sell), for instance, pound sterling on the spot at the current spot rate to sell (or buy) the currency in the future spot market, depending on his prediction on the spot rate of exchange on the future date. Consider, once again, the same set of data we have presented earlier (this time forward rate is being ignored for the obvious reason).

Current spot rate of exchange (S) = 2.00
One-year domestic rate of interest (r) = 10%
One-year foreign rate of interest (r^*) = 9.5%

Assume that the investor believes that the rate of exchange one year from the present day is going to go up, and assume that he thinks that it will be 3. Under this assumption, if he has one British pound one year from the present, he will be able to sell that pound for \$3.00. Since the present value of £1 a year from now will be £$1/(1+r^*)$ (which is, in numerical example in this case, is equal to £0.9113242 = 1/1.095), the investor needs $S/(1+r^*)$ dollars (that is, \$2/1.095) now. The cost of borrowing (or the opportunity cost of) this dollar amount for one year from the present day being factored into the calculation, the dollar amount at the end of one year becomes equal to $S(1+r)/(1+r^*)$, or 2(1.1)/1.095. Then one may easily derive the following decision rules.

If $\tilde{S} > S(1+r)/(1+r^*)$, buy foreign currency spot, and total profit is defined by:

$$= \left[\tilde{S} - S\frac{(1+r)}{(1+r^*)}\right]\cdot A_S. \tag{8.4}$$

If $\tilde{S} = S(1+r)/(1+r^*)$, buy or sell foreign currency spot, and total profit is *zero:*

$$= \left[\tilde{S} - S\frac{(1+r)}{(1+r^*)}\right]\cdot A_S. \tag{8.5}$$

If $\tilde{S} < S(1+r)/(1+r^*)$, sell foreign currency spot, and total profit is measured by:

$$= \left[S\frac{(1+r)}{(1+r^*)} - \tilde{S} \right] \cdot A_S. \tag{8.6}$$

Here A_S is the size of the spot contract in foreign currency denomination. One should recognize that if the prediction on the one-year spot rate is proven incorrect, the investor may end up with a reduced profit from his original estimate or with a loss, depending upon the actual value of the future spot rate of exchange.

Take a close look at the spot speculation, forward speculation, and arbitrage, which is brought out in this context as well. Note the following profit measures out of these three operations in the currency market:

$$P_S = \tilde{S} - S\frac{(1+r)}{(1+r^*)} \tag{8.7}$$

is the measure of profit if the investor speculates in-the-spot market;

$$P_F = \tilde{S} - F \tag{8.8}$$

is the measure of profit if the investor speculates in the forward market;

$$P_A = F - S\frac{(1+r)}{(1+r^*)} \tag{8.9}$$

is the measure of (covered interest) arbitrage profit.

Combining these three measures of profit, one can easily rewrite equation 8.7 as follows:

$$P_S = \tilde{S} - S\frac{(1+r)}{(1+r^*)} = \left[\tilde{S} - F\right] + \left[F - S\frac{(1+r)}{(1+r^*)}\right] \tag{8.10}$$

Therefore, we find that:

$$P_S = P_F + P_A. \tag{8.11}$$

One may then conclude that spot speculation is equivalent to forward speculation and arbitrage altogether.

It is quite apparent at this stage that given the predicted value of the future spot rate of exchange, a speculator may engage in both spot and forward speculation. The speculator may find it profitable to engage in either of these speculative strategies. Look at Figure 8.2 in which the horizontal axis measures the predicted value of the future spot rate of exchange ($\tilde{S}$) and the vertical axis measures the forward rate of exchange (F). The distance OA measures the value $S(1 + r)/(1 + r^*)$ (in the illustrative case, it is equal to 2.0091324). The perpendicular ABC (which repre-

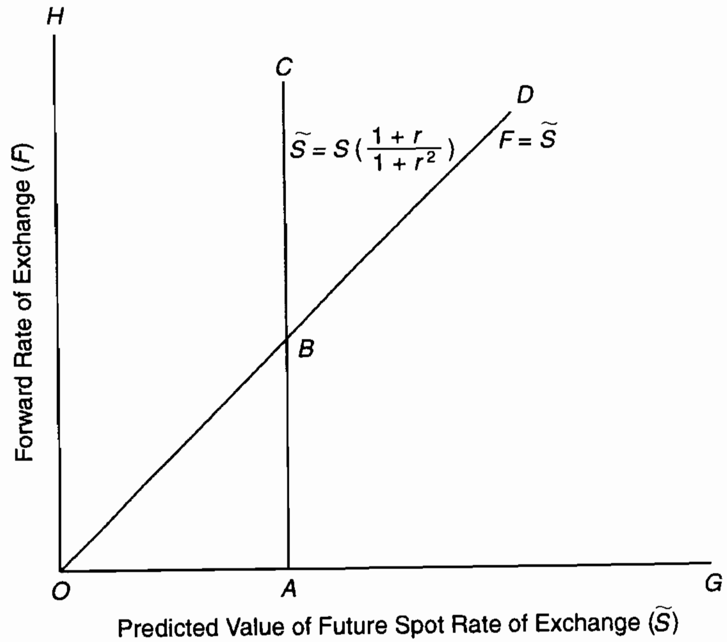

Figure 8.2 Profit (loss) possibilities with naked spot speculation

sents the condition of equality $\tilde{S} = S(1 + r)/(1 + r^*)$) is the dividing line between spot purchase and spot sell positions in the speculative strategy. The area to the left of this ABC line defines the condition in which $\tilde{S} < S(1 + r)/(1 + r)$—which signifies the spot sell of the foreign currency. The zone to the right of line ABC obviously earmarks the profitable area for speculative spot purchase of foreign currency. On line ABC, the investor is choice-neutral. Next, look at the 45° line OBD, which represents the equality between forward rate and future spot rate of exchange: $F = \tilde{S}$. Along this line, the investor should be indifferent between forward purchase and forward sale. But in the zone above this line, $\tilde{S} < F$, which means that the profit-seeking speculator will sell the foreign currency forward. In the opposite scenario—that is, below this line OBD (which depicts the condition: $\tilde{S} > F$), the investor will take the speculative position to buy foreign currency at the forward rate. Notice how this diagram has four distinct zones: (a) triangular area OAB, (b) open-ended area $GABD$, (c) cone-type area CBD, and (d) area $HOBC$. If the investor locates himself at point B (which is the intersection between OBD and ABC), he will find that speculation—both spot and forward—results in the zero-profit condition. Any other point of strategy in this diagram will offer some profitable situation. A close examination of this diagram reveals that in all of the zones carved out, there are two strategic speculative choices for the investor. In the triangular zone OAB, the investor has the following choices: (a.i) sell foreign currency spot and (a.ii) buy foreign currency forward. In zone $GABD$, he can choose either of the two: (b.i) buy foreign currency spot and (b.ii) buy foreign currency forward. In zone CBD, he has these two choices: (c.i) sell foreign currency forward (c.ii) buy foreign currency spot, and finally, in zone $HOBC$, he can go for (d.i) sell foreign currency forward and (d.ii) sell foreign currency spot. All these can be more clearly stated as follows.

If:

$\tilde{S} < F$ and $\tilde{S} < S\dfrac{(1+r)}{(1+r^*)}$, sell foreign currency spot or buy it forward; (8.12)

$\tilde{S} < F$ and $\tilde{S} > S\dfrac{(1+r)}{(1+r^*)}$, sell foreign currency spot or buy it forward; (8.13)

$\tilde{S} > F$ and $\tilde{S} > S\dfrac{(1+r)}{(1+r^*)}$, sell foreign currency spot or sell it forward; (8.14)

$\tilde{S} < F$ and $\tilde{S}$, sell foreign currency spot or sell it forward; (8.15)

The most pressing question is then: of the two choices in a given zone, which one is the better (superior) one for the investor? To answer this question, one should ascertain the rates of returns of the competing pair of choices in each strategic zone. In zone OAB (where $\tilde{S} < F$ and $\tilde{S} < S(1+r)/(1+r^*)$), the rate of return on selling foreign currency spot is equal to $[\{S(1+r)/(1+r^*)\}/\tilde{S}]$, and the rate of return on buy foreign currency forward is defined by $[\tilde{S}/F]$. So, it appears then that if:

$\dfrac{S\frac{1+r}{1+r^*}}{\tilde{S}} > \dfrac{\tilde{S}}{F}$, he should sell foreign currency spot instead of selling it forward; (8.16)

$\dfrac{S\frac{1+r}{1+r^*}}{\tilde{S}} < \dfrac{\tilde{S}}{F}$, he should buy foreign currency forward instead of selling it spot. (8.17)

From equations 8.16 and 8.17, one can then derive that if:

$F > \dfrac{\tilde{S}^2}{S\frac{1+r}{1+r^*}}$, he should sell the foreign currency spot instead of buying it forward; (8.18)

$F < \dfrac{\tilde{S}^2}{S\frac{1+r}{1+r^*}}$, he should buy foreign currency forward instead of selling it spot. (8.19)

Obviously, $F = \dfrac{\tilde{S}^2}{S\frac{1+r}{1+r^*}}$ is the dividing curve between the above two choices. (8.20)

In Figure 8.3, the curve OBE is the dividing line that represents the condition: $F = \tilde{S}^2/\{S(1+r)/(1+r^*)1+r\}$. So, above curve OBE, the investor should engage only in selling foreign currency spot; below this curve, he should buy foreign currency forward.

Next, consider the rates of return from speculative forward sale and speculative spot purchase of the foreign currency. The rate of return on the speculative forward sale of the foreign currency is defined by $F/\tilde{S}$, and the rate of return on speculative spot purchase is given by $\tilde{S}/S\{(1+r)/(1+r^*)\}$. Then if:

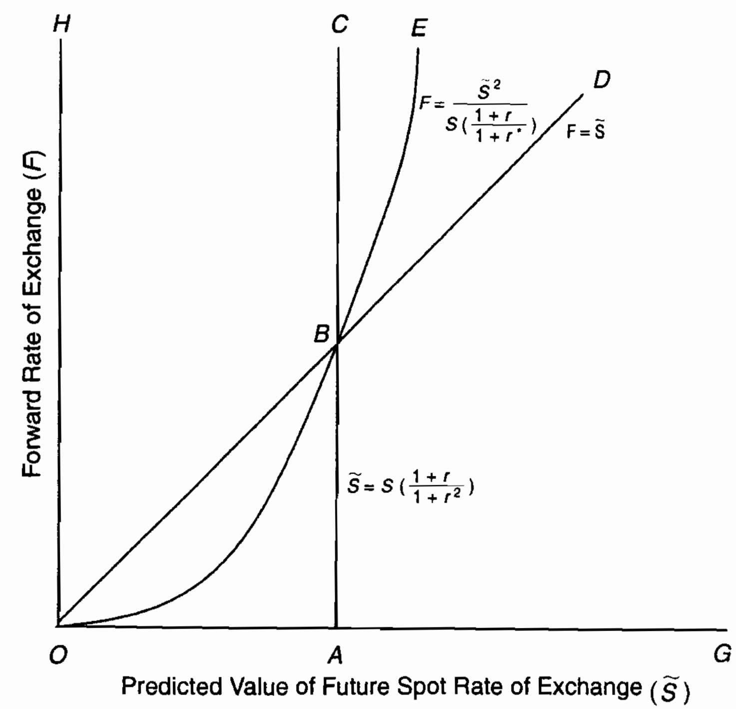

Figure 8.3 Profit menu with single choice under speculation

$$\frac{F}{\tilde{S}} > \frac{\tilde{S}}{S\frac{1+r}{1+r^*}} >, \text{ he should sell foreign currency forward instead of buying it spot;} \tag{8.21}$$

$$\frac{F}{\tilde{S}} < \frac{\tilde{S}}{S\frac{1+r}{1+r^*}}, \text{ he should buy foreign currency spot instead of selling it spot;} \tag{8.22}$$

and if:

$$\frac{F}{\tilde{S}} = \frac{\tilde{S}}{S\frac{1+r}{1+r^*}}, \text{ he should be indifferent to the above two choices.} \tag{8.23}$$

It is easily realized that this set of conditions are the same as the one we just derived to determine if the investor should sell foreign currency spot or buy it forward. One may state that if the investor is above the curve *OBE*, then he should sell forward instead of buying the foreign currency spot. Now, it is instructive to check into the zones *HOBC* and *GABD*. In zone *HOBC*, already noted, choices are selling spot and selling forward, and zone *GABD* presents the options of buying spot and buying forward. The rate of return out of selling spot is measured by $[\{S(1+r)/(1+r^*)\}/\tilde{S}$, and the rate of return on selling forward is computed by $F/\tilde{S}$. One can now realize that if:

$$\frac{S\frac{1+r}{1+r^*}}{\tilde{S}} > \frac{F}{\tilde{S}},$$

which is equivalent to:

$$S\frac{1+r}{1+r^*} > F, \text{ he should sell foreign currency spot instead of selling it forward;} \tag{8.24}$$

$$S\frac{1+r}{1+r^*} < F, \text{ he should sell foreign currency forward instead of selling it spot.} \tag{8.25}$$

Similarly, one can determine that if:

$$S\frac{1+r}{1+r^*} > F, \text{ he should buy foreign currency forward instead of buying it spot;} \tag{8.26}$$

$$S\frac{1+r}{1+r^*} < F, \text{ he should sell foreign currency forward instead of selling it spot.} \tag{8.27}$$

Figure 8.4 presents a new set of strategic zones defined by two curves, *OBE* (which represents $(\tilde{S}^2/\{S(1+r)/(1+r^*) = F)$ and *KBJ* (for which $S(1+r)/(1+r^*) = F$). To the left of *OBE* curve and under *KBJ* line, the investor should sell foreign currency spot; to the left of *OBE* curve and above *KBJ* line, the investor should sell foreign currency forward; to the right of *OBE* curve and under *KBJ* line, the investor should buy foreign currency forward, and to the right of *OBE* curve and above *KBJ* line, the investor should buy foreign currency spot.

More clearly, when:

$$F > \frac{\tilde{S}^2}{S\frac{1+r}{1+r^*}}, \text{ and } S\frac{1+r}{1+r^*} > F, \text{ and , he should sell foreign currency spot;} \tag{8.28}$$

$$F > \frac{\tilde{S}^2}{S\frac{1+r}{1+r^*}}, \text{ and } S\frac{1+r}{1+r^*} < F, \text{ and , he should sell foreign currency forward;} \tag{8.29}$$

$$F < \frac{\tilde{S}^2}{S\frac{1+r}{1+r^*}}, \text{ and } S\frac{1+r}{1+r^*} < F, \text{ and , he should buy foreign currency forward;} \tag{8.30}$$

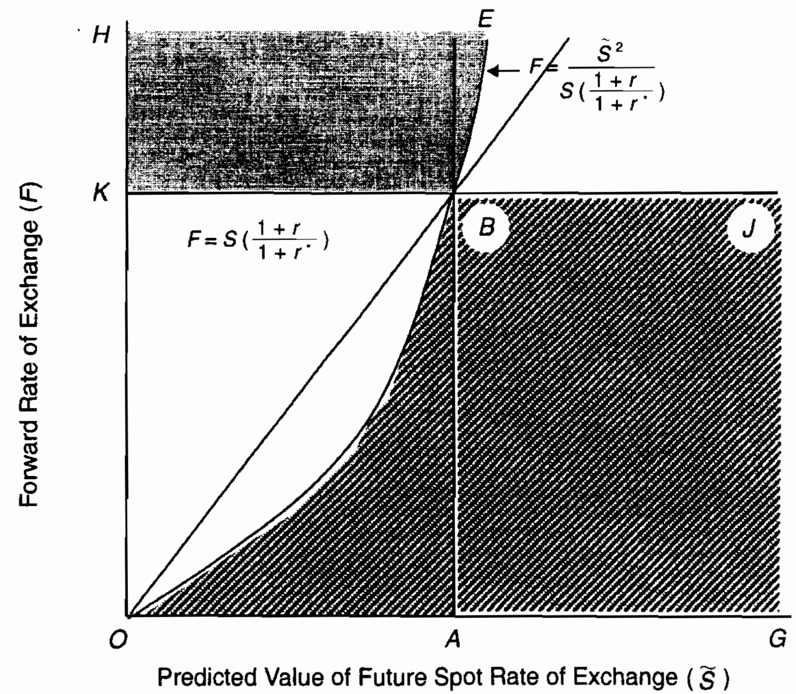

Figure 8.4 Profit zones with single strategy under speculation

$$F < \frac{\tilde{S}^2}{S\frac{1+r}{1+r^*}}, \text{ and } S\frac{1+r}{1+r^*} > F, \text{ and , he should buy foreign currency spot.} \quad (8.31)$$

FORWARD SPECULATION AND SPOT SPECULATION WITH TRANSACTION COSTS

In this section, we reexamine the conditions for forward and spot speculation with transaction costs. Recently, many works have taken the position of introducing the spread between *ask* and *bid* quotations in-the-spot and forward markets to capture one type of transaction costs, and the difference between the *borrowing* rate and the *lending* rate of interest as the other type of transaction costs in the investment process. Let us rewrite these quotations as follows.

Current spot *ask* rate of exchange (S^a)
Current spot *bid* rate of exchange (S^b)
One-year forward *ask* rate of exchange (F^a)
One-year forward *bid* rate of exchange (F^b)
Predicted spot *ask* rate of exchange one year from now ($\tilde{S}^a$)
Predicted spot *bid* rate of exchange one year from now ($\tilde{S}^b$)
Domestic interest rate of *borrowing* (r_B)
Domestic interest rate of *lending (investing)* (r_L)
Foreign interest rate of *borrowing* (r_B^*)
Foreign interest rate of *lending (investing)* (r_L^*)

Forward Speculation with Transaction Costs

Following the procedures outlined earlier, we can state the rules of rational investment behavior of a speculator as follows. If:

$$F^a < \tilde{S}^b, \text{ buy foreign currency forward, and total profit} = (\tilde{S}^b - F^a)\cdot A_F; \quad (8.32)$$

$$F^b < \tilde{S}^b, \text{ sell foreign currency forward, and total profit} = (\tilde{S}^b - F^b)\cdot A_F. \quad (8.33)$$

Assume, for the sake of simplicity, that S, F, and $\tilde{S}$ are the mid-rates of exchange. That is, S is the mid-rate between S^a and S^b, F is the mid-rate between F^a and F^b, and $\tilde{S}$ the mid-rate between $\tilde{S}^a$ and $\tilde{S}^b$. Under these assumptions then, one can have the following relationships.

$$S^a = S(1+T_S),\ S^b = \frac{S}{1+T_S}$$

$$F^a = F(1+T_f),\ F^b = \frac{F}{1+T_f}$$

$$\tilde{S}^a = \tilde{S}(1+T_{\tilde{S}}),\ \tilde{S}^b = \frac{\tilde{S}}{1+T_{\tilde{S}}}$$

$$r_B = r(1+\tau),\ r_L = \frac{r}{1+\tau},\ r_B^* = r^*(1+\tau^*), \text{ and } r_L^* = \frac{r^*}{1+\tau^*}.$$

Here $T_{s'}$, and T_f are the transaction costs on current spot, forward, and future spot markets. Similarly, τ and τ^* measure the transaction costs associated with interest rates in the domestic and foreign markets, respectively. Now, one can rewrite (8.32) as follows. When:

$$F(1 + T_f)(1 + T_{\tilde{S}}) < \tilde{S}, \text{ buy foreign currency forward.} \quad (8.34)$$

Similarly, (8.33) can be re-expressed as follows:

$$F > \tilde{S}(1 + T_f)(1 + T_{\tilde{S}}), \text{ sell foreign currency forward.} \quad (8.35)$$

Figure 8.5 shows a profitable forward speculation. The horizontal and vertical axis measure predicted future mid-spot rate of exchange ($\tilde{S}$) and mid-forward rate of exchange (F), respectively. The 45E line OA depicts the condition: $F = \tilde{S}$. The line OB represents $F = \tilde{S}(1 + T_f)(1 + T_{\tilde{S}})$, and line OC defines the condition $F = \tilde{S}/(1 + T_f)(1 + T_{\tilde{S}})$. Obviously then, in the area above the line OB in this diagram, $F > \tilde{S}(1 + T_f)(1 + T_{\tilde{S}})$, which means that the speculator should sell foreign currency forward. In area below the line OC where $F < \tilde{S}/(1 + T_f)(1 + T_{\tilde{S}})$, the profit-seeking speculator should buy foreign currency forward. In the cone BOC, there is no scope for profitable arbitrage. A close look at the diagram reveals that the greater the transaction costs, the further out lines OB and OC will be from line OA, which in turn would indicate the smaller scope for profitable forward speculation.

Spot Speculation with Transaction Costs

Again, the same procedures as before yields that the speculator should buy foreign currency spot if:

$$\tilde{S}^b > S^a\frac{1+r_B}{1+r_L^*},$$

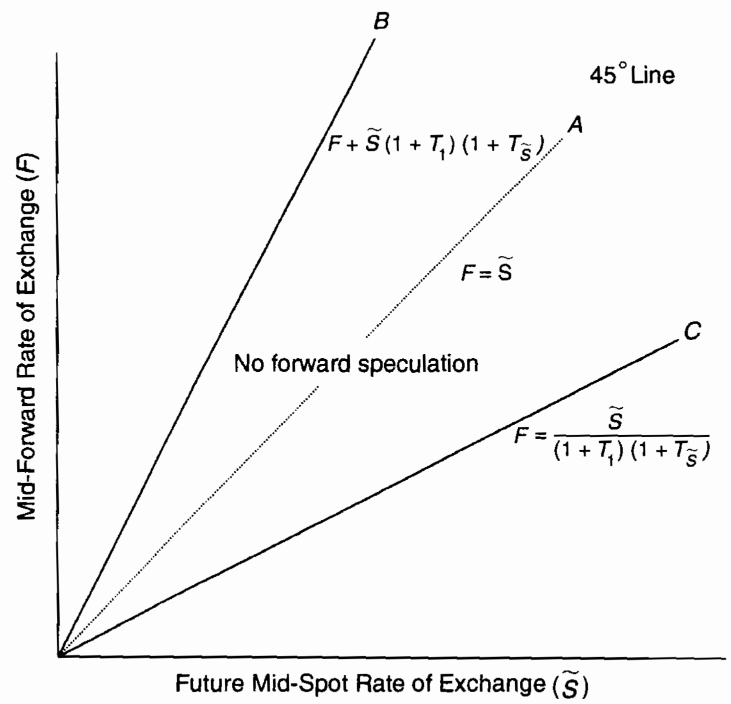

Figure 8.5 Zones of profitable/unprofitable forward speculation

which is equivalent to:

$$\tilde{S} > S\frac{(1+T_S)(1+T_{\tilde{S}})(1+r_B)}{(1+r_L^*)}. \tag{8.36}$$

The investor should sell foreign currency spot provided the following holds:

$$S^b > \tilde{S}^a,$$

which means:

$$S > \tilde{S}(1+T_s)(1+T_{\tilde{S}}). \tag{8.37}$$

Figure 8.6 portrays the profitable choices of the speculator in-the-spot market. Here, the horizontal and the vertical axis also represent $\tilde{S}$ and F. The perpendicular KL defines $\tilde{S} = S/(1+T_s)(1+T_{\tilde{S}})$, and the perpendicular

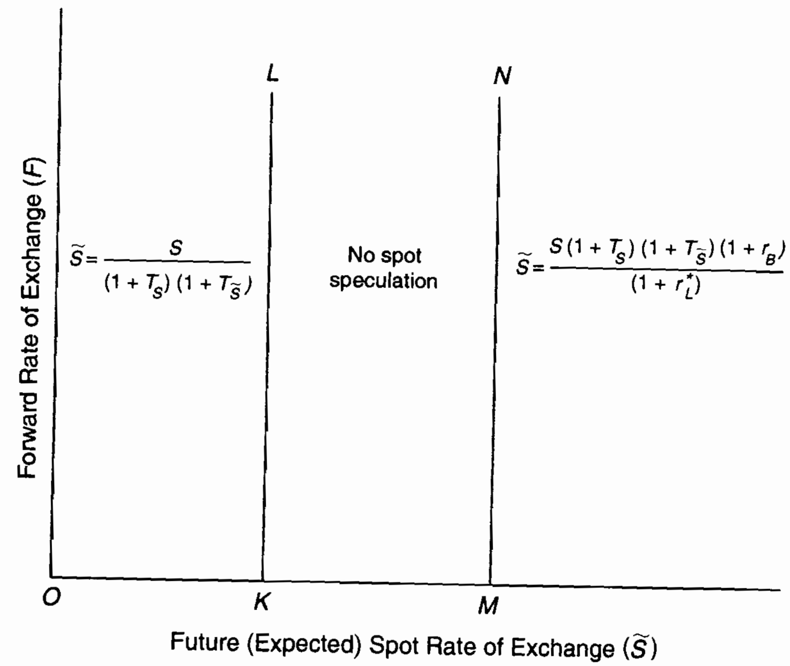

Figure 8.6 Spot speculation

MN represents $\tilde{S} = S(1+T_s)(1+T_{\tilde{S}})(1+r_B)/(1+r_L^*)$. The area to the left of line KL then represents the condition that $\tilde{S} < S/(1+T_s)(1+T_{\tilde{S}})$. So in this area—that is, for any combination of F and $\tilde{S}$ that lies in this area—the speculator should sell the foreign currency spot. It is evident, as it ought to be, that there is no constraint on the forward rate (since it is a spot market strategy alone). The area to the right of the vertical line MN (for which obviously $\tilde{S} > S(1+T_s)(1+T_{\tilde{S}})(1+r_B)/(1+r_L^*)$) defines the scope for profitable speculation when the investor buys foreign currency spot. The area between lines KL and MN defines the corridor that offers no scope for profitable spot speculation. It should be pointed out that the higher the transaction costs, the wider the corridor, and vice versa. If the foreign lending rate r_L^* is very high, then, *ceteres paribus*, it may tend to exert the effect of narrowing the corridor on nonprofitable spot speculation. One may recall the interest rate relationships we have outlined earlier: $r_B = r(1+\tau)$, $r_L^* = r^*/(1+\tau^*)$, make use of these relationships in (8.36), and arrive at:

$$\tilde{S} > S\frac{(1+T_S)(1+T_{\tilde{S}})(1+r)(1+\tau)(1+\tau^*)}{(1+r^*)}. \tag{8.38}$$

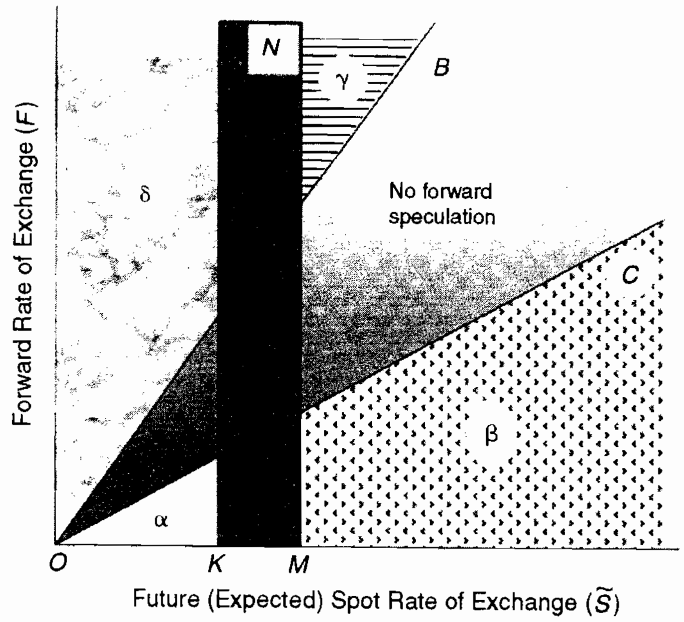

Figure 8.7 Spot and forward speculation

Forward and Spot Speculation in One Framework

Now, combine Figure 8.5 and Figure 8.6. This shows the graph presented in Figure 8.7. Here cone *BOC* specifies the zone of no forward speculation, and the vertical corridor between lines KL and *MN* demarcates the zone of no spot speculation. The overlapping area obviously defines the scope of nonspeculative activities, both spot and forward. In this diagram, the triangular area (designated here as α) offers the scope for the speculative sell of foreign market and the purchase of it in the forward market. Area β defines the buy forward and sell spot strategy. The area denoted by γ is for buying in the spot market and selling in the forward market, and finally, zone δ prescribes the strategies of sell spot and sell forward. Once again, we provide the following rules of decision for the speculators in the designated zones as follows:

α: sell foreign currency spot, or buy it forward; (8.39)
β: buy foreign currency spot, or buy it forward; (8.40)
γ: buy foreign currency spot, or sell it forward; (8.41)
δ: sell foreign currency spot, or sell it forward. (8.42)

Once again, one has to choose between the two profitable choices in each area of operation. The exact procedures that we used in the absence of transaction costs will narrow the choice set under different conditi...

COVERED SPECULATION

In this section, we attempt to step out of the zone of unguarded risk by offering some levels of insulation through derivative securities on the currencies under consideration. We specially present some currency options—put and/or call or synthetic combinations thereof—to protect a speculator who has love for risk for better returns but does not wish to sustain a great deal of loss for his lust for money. What can he do under this situation? In this part of the present work, we show a number of possibilities that may sterilize the investor from financial catastrophe resulting from his speculative zeal.

Consider the earlier data and a put option with the following information on it: put option premium (P_p) = \$0.05, its exercise price (X_p) = \$2.35, and its time to expiration matching the maturity of the forward contract. Under this situation, the effective exercise price of the put (X^*_p) is \$2.35 – \$0.05 = \$2.30. In this event, if the speculator expects the future spot rate to be \$3.00, he should buy a pound forward with the purchase of a put. If the future spot rate proves incorrect, he still has the option of getting out with a profit of \$0.15 (= \$ \$2.30 – \$2.15) per pound upon the exercise of the option. As long as the effective exercise price (X^*_p) is greater than or equal to the forward quote, speculative position with forward and put purchase of pound cannot hurt. If the probability of the exercise of the put equals the probability that the investor's expected value of the spot rate will prove true, then speculation is gainful. Technically, $E(\pi) = \{p_1(X^*_p - F) + p_2(\tilde{S} - F)\}A_F$, where π stands for profits, p_1 measures the probability of exercising the option, and p_2 measures the probability of realizing the expected outcome $\tilde{S}^+$. That means, in this illustrative case, $E(\pi)$ = {2(\$0.15) + 2(\$0.85)}1,000,000 = \$500,000 (the contract size being £1,000,000). If the put is available for \$0.05 with the exercise price of \$2.15 (and hence the effective exercise price of \$2.10), the expected value of the same speculative strategy will be {2(\$2.10 – \$2.15) + 2(\$3.00 – \$2.15)}1,000,000 = \$400,000. From these illustrations, one may easily arrive at the conclusion that as long as the effective exercise price of the put option is at most the positive difference between the expected future spot rate and the forward rate, speculation is financially worthwhile. Figure 8.8 depicts the kind of speculation the investor should engage in.

So far, we have looked at the expectation that the future spot rate will be above the forward rate. If, however, the expected value on the future spot rate is below the currently quoted forward rate—that is $F = 2.15$ and $\tilde{S}^+ = 2.00$, the investor should enter into a forward sell contract on the British pound. By entering into this sell contract, he will sell pound to get \$2.15 on each pound sold at the end of the contract maturity, then buy each pound for \$2.00, thus making a profit of \$0.15 per pound. Given this scenario, if the expectation is realized, the naked speculative long on forward contract ...

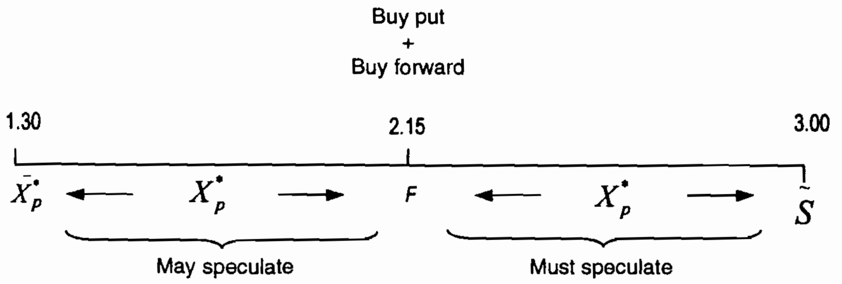

Figure 8.8 Covered speculation with put option

= 2.00, he may (should) hedge his exposure by buying a call option at some appropriate cost. If a call is available at an exercise price of $2.05 for a premium of, say, $0.05, his effective exercise price then becomes $2.10, and his profit upon a possible exercise of the option comes out to be $2.15 – $2.10 = $0.05 per pound. His expected profit is measured by the following:

$$E(\pi) = \{p_1(F - X^*_c) + p_2(F - \tilde{S}^+)\}A_F$$

In this instance, the profit out of a contract of £1,000,000 is then {2($2.15 – $2.10) + 2($2.15 – $2.00)}1,000,000 = $100,000. It is clear from this case that as long as $X^*_c \# F$, there is no loss in going long on a call. More correctly, as long as $\tilde{S}^+ \leqslant X^*_c \leqslant F$ holds, there is no loss (profits in strict inequality conditions). Figure 8.9 defines the covered profit opportunities and further specifies conditions when one must and when one may profitably speculate with mathematical expectation. In our analysis, we have only considered the possible two outcomes, which may be all right if we are with the European options and the expected value of future spot rate is fixed. However, when American options are introduced in the picture, any outcome from X^*_p to $\tilde{S}^+$ may occur with equal probability. The probability density for this situation is appropriately defined by the uniform distribution:

$$\int_{-\infty}^{\tilde{S}^+} f_s(S)dS, \text{ where } f_S(S) = \frac{1}{\tilde{S}^+ - X^*_c},\ X^*_c < S < \tilde{S}^+; = 0, \text{ otherwise.}$$

$$= 0 \text{ for } \tilde{S}^+ < X^*_p$$

$$= \frac{Z - X^*_c}{\tilde{S}^+ - X^*_c} \text{ for } X^*_p \# Z \# \tilde{S}^+$$

$$= 1 \text{ for } Z > \tilde{S}^+.$$

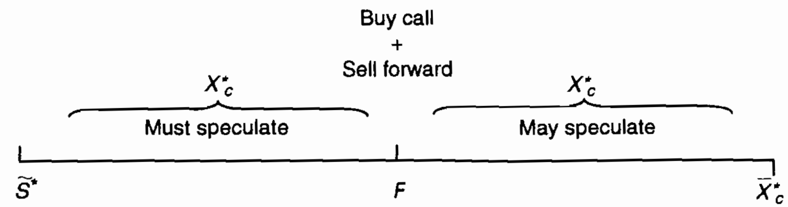

Figure 8.9 Covered speculation with call option

From this probability distribution, the mean $(\Phi_S) = E(S)$, and variance (σ^2) are as follows:

$$\phi_S = \frac{\tilde{S}^+ + X^*_c}{2},\ \sigma^2 = \frac{\left(\tilde{S}^+ - X^*_c\right)^2}{12}.$$

Similar results are in order for call options in the American style. These calculations are meaningful only in the event that the investor has either expectation that the value of the future spot rate will be either $\tilde{S}_u > F$ or $\tilde{S}_1 < F$. In reality, however, the investor may be given the prediction on future S within a range such that $\tilde{S}_1 < F < \tilde{S}_u$. In this situation, it appears that he should go long on both a put and a call. Before entering further into this range, we should consider the entire range of possible values on the future spot rate of exchange $(\tilde{S})$ in the interval between 0 and infinity. With effective exercise price of, say, a put option and the expected value of $\tilde{S}$ lying in the closed interval of 0 and 4, the probability density function must be a normal distribution of S, and the moment generating function is defined by the following expression:

$$\int_{X^*_c}^{\infty} \frac{1}{\sigma\sqrt{2\pi}} e^{-0.5\frac{(S-\mu)^2}{\sigma^2}} dS,$$

whence:

$\mu_s = \mu$, $\sigma_s^2 = \sigma^2$ are given by some *a priori* estimates.

Now we see that the investor is in a position of creating a rich variety of synthetic combinations when the expected value of the future spot rate of exchange is not known. Therefore, we attempt to illustrate a few cocktails with put and call options in this context.

Merton (1973), Garman and Kohlhagen (1983), and Grabbe (1983) have discussed a good deal on options that fit our specific conditions. With a full comprehension of these works and proper utilization of these models, the investor can create a number of straddles, strangles, or delta-neutral ratio spreads to create different U-shaped profit (loss) functions. A *straddle* or a *strangle* is a combination of a call and a put, but in a straddle both the exercise price and the expiration date on put and call are the same; in a strangle, put and call options have the same expiration date but different exercise price. A *spread* is combination of options of different series but of the same class. Figures 8.10, 8.11, 8.12, 8.13, and 8.14 exhibit profit (loss) functions of these three synthetics as follows. At this point, it should be noted that the lower the volatility (σ), the higher the loss, and the higher the volatility, the lower the loss (or greater the profit) for both straddle and delta-neutral ratio spread. A strangle profit is potentially greater with more time remaining and vice versa. If the calculation of the implied volatility exceeds the critical value, it pays to take the covered straddle or delta-neutral ratio spread. Here we present one interesting situation as portrayed by Figure 8.14. The U-shaped curve, *NZM*, here defines the profit levels at different future spot rates of exchange of the foreign currency. The 45° lines *RZ* and *VZ* in this diagram portray the conditions

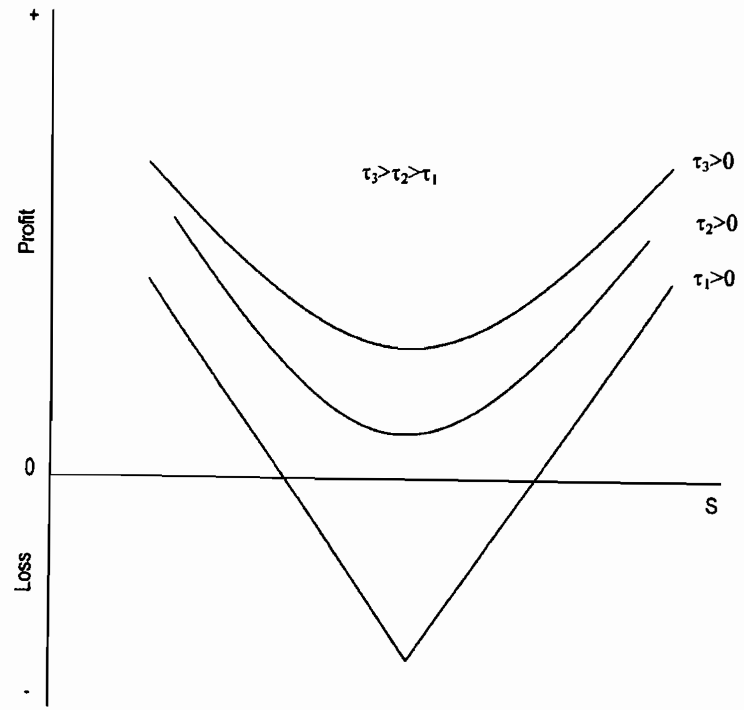

Figure 8.10 Option-based profit profiles at different expiration times.

under which synthetic options should or should not be exercised. In the open interval *AB*, exploiting the situation as if naked speculation exists is the better choice if *OZ* is the forward rate; but beyond the range *AB*, the investor should exercise the options (that is, delta-neutral ratio spread).

MORE ACTIVE SPECULATIVE STRATEGIES

Simple Scenario

In the previous section, we have outlined speculative choices, then narrowed the spectrum further and thus streamlined the operational decision rules for an investor. In this section, we go a step further and show that a more active investor with a more involved strategy set can do better. Remember that in the previous section, to enter into spot speculation, our investor has calculated the dollar cost of one foreign currency one year from that day, and as long as that cost is less (more) than the estimated value of $\tilde{S}$, he should buy (sell) spot contract in order to make a speculative profit. If he thinks that $\tilde{S} = 4.15$, and the current spot rate of exchange (S) = 2, r = 10 percent, and r^* = 9.5%, he will, as noted earlier, make a profit of (4.15 − 2.0091324) = 2.1408676 per pound (or $214,086,760 on a spot con-

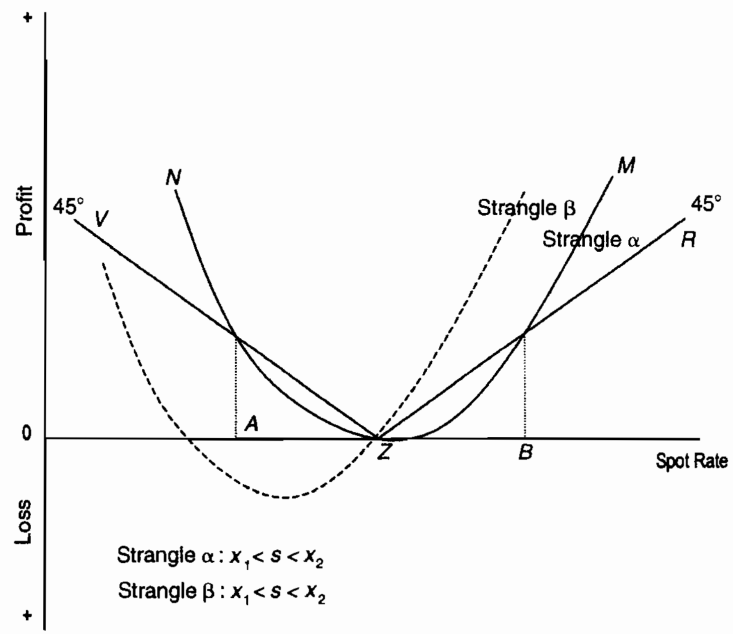

Figure 8.11 Profit (loss) possibilities with strangle

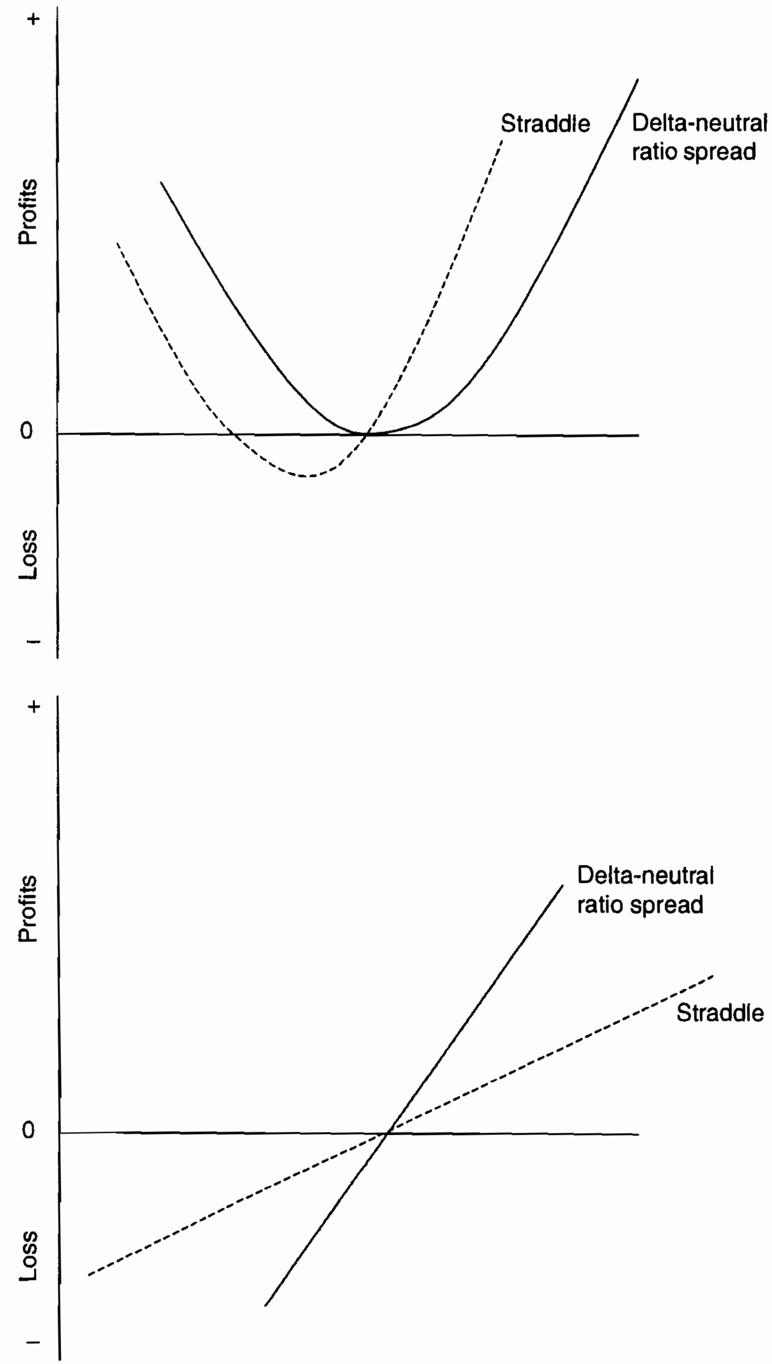

Figure 8.12 Profit (loss) possibilities with straddle and delta-neutral ratio spread

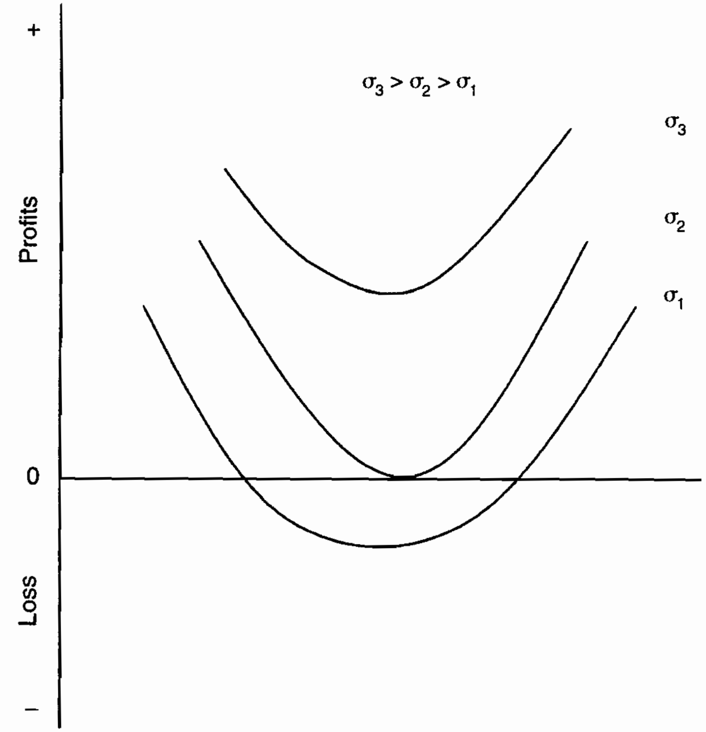

Figure 8.13 Profit (loss) possibilities with different volatilities

tract of £100,000,000). However, with the same set of market data, he can first convert his $2 amount into £1 at the spot market, and put this £1 into deposit in a British bank at 9.95 percent, and thus make his original $2 turn into £1(1 + 0.095) = £1.095 at the end of one year, which can then be sold at the then spot market and get $4.15(1.095) = $4.54425. He must now subtract $2(1 + 0.1) (which is the principal amount plus the accrued interest cost, which he borrowed either from a bank or from himself at 10 percent per annum) from $4.54425 to earn a net profit of $2.34425. On a contract size of A_S = £100,000,000, he now makes a total profit of $234,425,000, which is larger than $214,086,760 that we determined in the second section of this chapter. This excess $20, 338,240 is the additional bonus for being a more active spot speculator in the market. With this modified operational strategy, the investor's profits are measured by $[(1 + r^*)\tilde{S} - S(1 + r)] \cdot A_s$ (as opposed to $[\tilde{S} - S(1 + r)/(1 + r^*)] \cdot A_s$). On a forward speculation, no modification can be made to increase profit levels. So now the structure of decision rules is as follows: When:

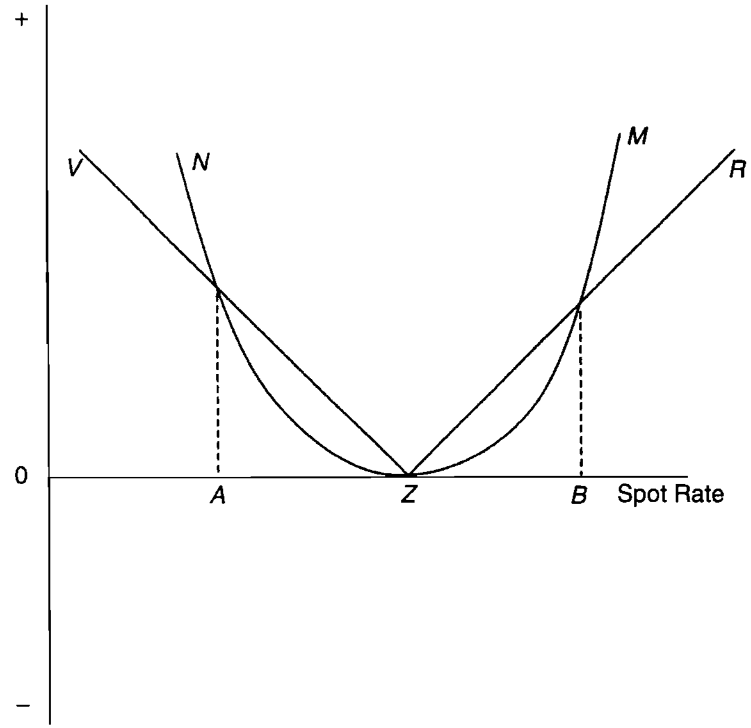

Figure 8.14 Profit possibilities: options *vis-à-vis* forward contracts

α: $\tilde{S} > F$, and $\tilde{S}(1 + r^*) < S(1 + r)$: (i) buy foreign currency forward, and (ii) sell it spot;
β: $\tilde{S} > F$, and $\tilde{S}(1 + r^*) > S(1 + r)$: (i) buy foreign currency forward, and (ii) buy it spot;
γ: $\tilde{S} < F$, and $\tilde{S}(1 + r^*) > S(1 + r)$: (i) sell foreign currency forward, and (ii) buy it spot;
δ: $\tilde{S} < F$, and $\tilde{S}(1 + r^*) < S(1 + r)$: (i) sell foreign currency forward, and (ii) sell it spot.

Although the dual strategies here have emerged in the modified structure with better profit opportunities, the uniquely superior strategic decision rules defined earlier by (a), (b), (c), and (d) still remain unscathed.

Complex Scenario

Consider the investor first converting his dollars into the foreign currency (pound sterling) in spot market, investing the foreign-currency-denominated amount in the foreign country at r^*, next selling the amount

at forward rate, and finally subtracting $S(1 + r)$ from that amount. It will give a profit of $(1 + r^*)F - S(1 + r)$ (if it is positive). Let it be defined as ρ_1. That is,

$$\rho_1 = (1 + r^*)F - S(1 + r),$$

the present value of which is $(\rho_{1(0)})$:

$$\rho_{1(0)} = (1/(1 + r)\{(1 + r^*)F - S(1 + r)\}\tilde{S}\beta,$$

$$\text{where } \beta \ \frac{(1+r^*)F/S-(1+r)}{1+r}.$$

Since this amount is the equity position of the investor at this point, he can make this amount plus the original S dollars to play for another round before the market data changes. Usually, market data stays the same from 20 seconds to several minutes in real life[1], and hence in the time interval within which data remain invariant, the investor with the speed of today's technology can play the arbitrage game a number of times. If that is the picture, then in the second play, he can put his $\$(S + \rho_{1(0)}))$ into covered trading and get the following profits after second round of play:

$$\rho_{2(0)} = \left(\frac{1}{1+r}\right)\left(\frac{S+\rho_{1(0)}}{S}\right)\{(1+r^*)F-(1+r)S\}$$
$$\tilde{S}\,\beta(\beta+1)^{2-1},$$

and after nth play:

$$\rho_{n(0)} = \left(\frac{1}{1+r}\right)\left(\frac{S+\rho_{1(0)}+\rho_{2(0)}+\ldots\rho_{(n-1)(0)}}{S}\right)[(1+r^*)F-(1+r)S]$$
$$\tilde{S}\beta(\beta+1)^{n-1}.$$

A point of clarification is needed at this stage rather urgently, otherwise the notion of double (or multiple) counting can cloud our mind.[2] Note that in the second round we plugged in the borrowed amount S dollars (which with the accrued interest on it must be paid again) plus $\rho_{1(0)}$, which is the investor's own fund now, and in the third round he puts in the borrowed amount S dollars plus the profit generated in the first round ($\rho_{1(0)}$) and in the second round ($\rho_{2(0)}$) just the way the original amount of S dollars is being reinvested in every round. So on the nth round, he invests S dollars plus the profit amounts made in the previous rounds (that is, $S + \Sigma_{i=1}^{n-1} \rho_{i(0)}$). This is the basic structure, envisioned in the work of Ghosh (1997a, 1997b), only modified by the fact that the total amount of funds put to work in each covered play consists of the initial fund plus the profits generated in the previous plays.[3]

Remember next that the investor, however, needs the foreign currency (British pound) to be able to sell that currency to buy the home currency (dollar, in this paradigm), and hence he will not sell pound forward on his last iteration; he will sell the pound in the future spot rate of exchange ($\tilde{S}$), and so his profits will be equal to the following measure in the speculative design upon the nth round ρ_n^s:

$$\rho_n^s = \left(\frac{S+\rho_{1(0)}+\rho_{2(0)}+\ldots+\rho_{(n-1)(0)}}{S}\right)\left[(1+r^*)\tilde{S}-(1+r)S\right]$$

$$= \omega + \omega\beta\left[\frac{1-\gamma^{n-1}}{1-\gamma}\right],$$

where $\omega \equiv S[(1 + r^*)\tilde{S}/S - (1 + r)$, and $\gamma \equiv \beta + 1$.

For obvious reason, $\rho_{i(0)} = 0$ for $i = 1$.

Next, under the assumed market data set $\tilde{S} = 4.15$, $F = 2.15$, $S = 2.00$, $r = 0.1$, and $r^* = 0.095$, one can compute the speculative profit measures with the mixed bag of strategies involving spot and forward rates as opposed to simple spot speculation (as depicted in the previous sections) as given in Table 8.1.

Table 8.1 hardly needs any further interpretation. Look at the row for the value of $n = 1$ first. If the investor enters into spot speculation, his net profit out of his purchase of £1 now is $2,34425 (given in column 2), and if his initial purchase of the British pound at the spot rate of 2 is £100,000,000, he makes a net profit of $234,425,000 (given in column 3). If the investor can play covered trade with forward contracts under the given market data for one round, then put the profits generated by covered trade in the speculative play. He plays two rounds from which he can make $3.508613829 for his initial purchase of £1 in the spot market and with his purchase of £100,000,000 in the spot market. He can earn a net profit of $250,861,389. Similarly, upon the completion of ten rounds then he can generate the hefty amount of $431,392,916 for an initial spot purchase of British pound with a spot contract size of £100,000,000. Straight spot or forward speculation will provide so little by comparison that an active speculator must not consider simple strategy any more. Remember that the quotes taken for market data are simply for demonstrative purpose, and hence, these extraordinarily large sums of profits may not reflect the reality, although the magnification factors are certainly the main thrust of this work.

A few more remarks should be made at this point. As one knows already that if $(1 + r^*)\tilde{S} - (1 + r)S < 0$, the investor sells foreign currency

Table 8.1
Measures of Arbitrage Profits with Speculation

i	ρ_i^s	$A_s \cdot \rho_i^s$
1	2.34425	$234,425,000
2	3.508613892	250,861,389
3	2.684501934	268,450,193
4	2.872722127	287,272,213
5	3.074139121	307,413,912
6	3.289678194	328,967,819
7	3.520329494	352,032,949
8	3.767152596	376,715,260
9	4.031281364	403,128,136
10	4.313929916	431,392,916

Speculative profits per pound (foreign currency) (ρ_i^s) and total profits per contract size in British pound ($A_s \cdot$) in U.S. dollars (domestic currency) with cumulative iterations where i is the index of cumulative speculative play ($\rho_i^s = 1, 2, 3, \ldots$). Here, spot rate of exchange (S) = 2.00, one-year forward rate of exchange (F) = 2.15, domestic interest rate (r) = 0.1, foreign interest rate (r^*) = 0.095, (expected) future spot rate ($\tilde{S}$) = 4.15, and spot and forward contract size in British pound (A_S) = A_F = $100,000,000.

forward, then the profit measures will be exactly the same because of the reversed strategy in place in symmetric fashion. However, once the transaction costs are factored in, reversal of strategy may not ensure the desired result defined for the trading environment without transaction costs.

Although without substantiation in this chapter, we find that in the presence of transaction costs there are ranges in which neither spot nor forward speculation will be unprofitable.

CONCLUDING REMARKS

In this chapter we merely attempt to demonstrate that a synthetic structure of currency derivatives in the form of straddle, strangle, and ratio spread can completely, or virtually, eliminate loss and potentially create profit condition under speculative situations. There are numerous combinations—sometimes short positions on options—that can create a better insulation for speculative ventures of an investor. The parabolic profit (loss) functions, the computation of the foci, and the directrices may be the tasks before the investor. Once they are computed and the probability distributions are reasonably captured, speculation is not really a leap into the dark.

This chapter delineates conditions for profitable profit opportunities and specifies speculative strategies with and without cover when anticipated future spot rate of exchange is taken as given. No attempt is made to forecast the future spot rate, but given any expected rate, what the profitable speculative strategies would be is spelled out in a simple environment by making use of current spot and forward rates of exchange and the given interest rates. A more complex trading and speculative designs are also provided in this work when the trader is capable of undertaking iterative arbitrage before the final act of trading with speculation. A numerical illustration of the enormous profit possibilities is computed for each foreign currency and for a given contract size. Additional work involving forward contract on interest rate, as enunciated by Ghosh (1998), or a more stochastic dynamics of interest rates with Brownian motion and Ito's lemma is a possible extension of this chapter.

NOTES

1. Based on the observations of real-time data screen of *Reuters* for months and months in the trading room in CETFI, Marseille, France, and in a currency trading house in Princeton, New Jersey, the authors have been able to make this statement.

2. It may appear that we are making double (or multiple) counting. Note that first, the investor starts with S dollars (borrowed from his bank or from himself) and then converts the amount into British pound and puts the pound amount at the British rate (r^*). He then sells the amount $(1 + r^*)$ at the forward rate—and thus gets the British pound amount converted back in dollars (here that is \$$(1 + r^*)F$). Now he pays off the principal with accrued interest, which is \$$S(1 + r)$, and so his total profit for \$$S$ (here denoted by ρ_1) is equal to$(1 + r^*)F - S(1 + r)$, and its present value ($\rho_{1(0)}$) is:

$$\rho_{1(0)} = \{1/(1 + r)\}[(1 + r^*)F - S(1 + r)]/S\beta, \text{ where } \beta = \frac{(1+r^*)\frac{F}{S}-(1+r)}{(1+r)}$$

defined on p. 10 in this current version. This $\rho_{1(0)}$ is the profit made on the first round of arbitrage, and this amount $\rho_{1(0)}$ is put just like the amount S dollars for the

second round of arbitrage, and then he makes $\rho_{2(0)}$ by making use of \$$(S + \rho_{1(0)})$. For the third round then he puts the amount \$$(S + \rho_{1(0)} + \rho_{2(0)})$ into play. This process leads to $\rho_{n(0)}$.

One can arguably point out that interest expense on $\rho_{1(0)}$ should also be deducted to account for the opportunity cost of the investor's own funds. Ghosh [11] has indeed referred to that in clear terms.

3. One can introduce the notion of additional leverage, by making use of $(S\Sigma_{i=1}^{n-1}\rho_{i(0)})(1+ \theta)$, where θ is the percentage of funds that investor has under risk-free investment environment. The authors are indebted to Lloyd P. Blenman for pointing out this possible and sharper scenario.

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