Is the Foreign Exchange Market Inefficient?

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Suppose you are in charge of investments for your company and you have 1 million U.S. dollars to invest for one month. You want to obtain the highest return possible for the month while assuming minimal risk, so you decide to invest in short-term government securities: Treasury bills. The rate of interest paid on U.S. Treasury bills maturing in one month is currently 4 percent annually. However, while reading the newspaper, you notice that Canadian Treasury bills maturing in one month are currently paying 5 percent annually. Why not sell the 1 million U.S. dollars for Canadian dollars at the present exchange rate, invest the proceeds in Canadian bills, and earn the 5 percent interest rate? Then, at the end of the month, convert the Canadian dollars back to U.S. dollars.

You tell your broker about your strategy, but he objects. "The foreign exchange market is efficient," he argues. "That means that investors eliminate exploitable profit opportunities. Interest rates are always different between countries. If higher interest rates in a foreign country really meant higher returns after taking expected exchange rate movements into account, in-

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vestors would have recognized that years ago. They would have moved funds from one country to another to capture those higher extra returns, making interest rates converge in the process. So, this extra return cannot really be available."

"But I can earn an extra 1 percent interest in the Canadian Treasury bill market," you protest. "Why isn't that an extra 1 percent return?" "Simple," replies your broker. "You have to convert the Canadian dollars back to U.S. dollars in a month, right? Given the current level of interest rates and the exchange rate, the market must expect that during the coming month, the Canadian dollar will lose value in terms of U.S. dollars at a 1 percent annual rate. That way, you lose the extra 1 percent return when you convert the Canadian dollars back into U.S. dollars. Besides, you can't be sure what the exchange rate will be when you convert back to dollars; so you will assume a lot of exchange rate risk."

Unconvinced, you decide to see what would have happened had you followed this strategy in the past. To do this, you look at monthly U.S.-Canadian interest and exchange rate data over the period June 1973 to April 1993. For each month, you would have invested $1 million in one-month U.S. T-bills whenever their interest rate was higher than that on one-month Canadian T-bills. However, in the months when the Canadian T-bill interest rate exceeded the U.S. T-bill interest rate, you would have converted $1 million into Canadian dollars and invested the sum in Canadian T-bills; at the end of the month, you would have converted the accumulated Canadian dollars back into U.S. dollars. Over this period, there were 170 months in which you would have made a Canadian T-bill investment. Surprisingly, you find that this strategy would have made an average $1072 per month in excess returns during the months you invested in Canadian T-bills. The broker is right about the exchange rate risk, though. Because of the volatility of the U.S.-Canadian dollar exchange rate, 26 percent of the time you would have lost more than $5000 per month during the months in which you invested in the Canadian T-bill (Figure 1).[1] Sometimes, the risk would have been quite large: during some months you would have lost approximately $40,000 per month, and in one particularly bad month, you would have lost almost $60,000. Thus, the average $1072 per month in extra returns involves substantial risk. Even though the risk-return tradeoff is not very good, do the extra returns mean that the foreign exchange market is inefficient?

In this article, we will consider this question. Some economists argue that statistical problems falsely make it look like the extra returns are there. Other economists do not deny that the extra returns exist: one group claims the extra returns are available because the market's expectation of the worth of future currencies is irrational; another group maintains that the extra returns can be explained as compensation to the investor for taking on the risk of losing money. Ultimately, as we will see, economists have not yet reached agreement; thus, we may not rule out the possibility that opportunities for extra returns do exist in the foreign exchange market.

EVIDENCE AGAINST MARKET EFFICIENCY

If markets are efficient, then when the annual foreign interest rate is x percentage points above the domestic interest rate, the foreign currency is expected to decline in value at an annualized rate of x percent. If these expectations are borne out on average, over time the extra x percent interest will be offset by the currency's fall in value. But historically, these expectations are not upheld: when foreign interest rates rise above U.S. rates, the foreign

[1]Similar results arise for the short-term debt issued by the governments of other major industrial countries.

currency tends to rise in value rather than fall. Moreover, when the U.S. interest rate rises above the foreign interest rate, the U.S. dollar tends, on average, to rise rather than fall in terms of the foreign currency.[2] These results suggest a profit-making strategy for the investor: if the investor always puts his funds into the short-term government securities of the major industrial country that pays the highest interest rate, he should make extra returns over time, calling into question the efficiency of the foreign exchange market.[3]

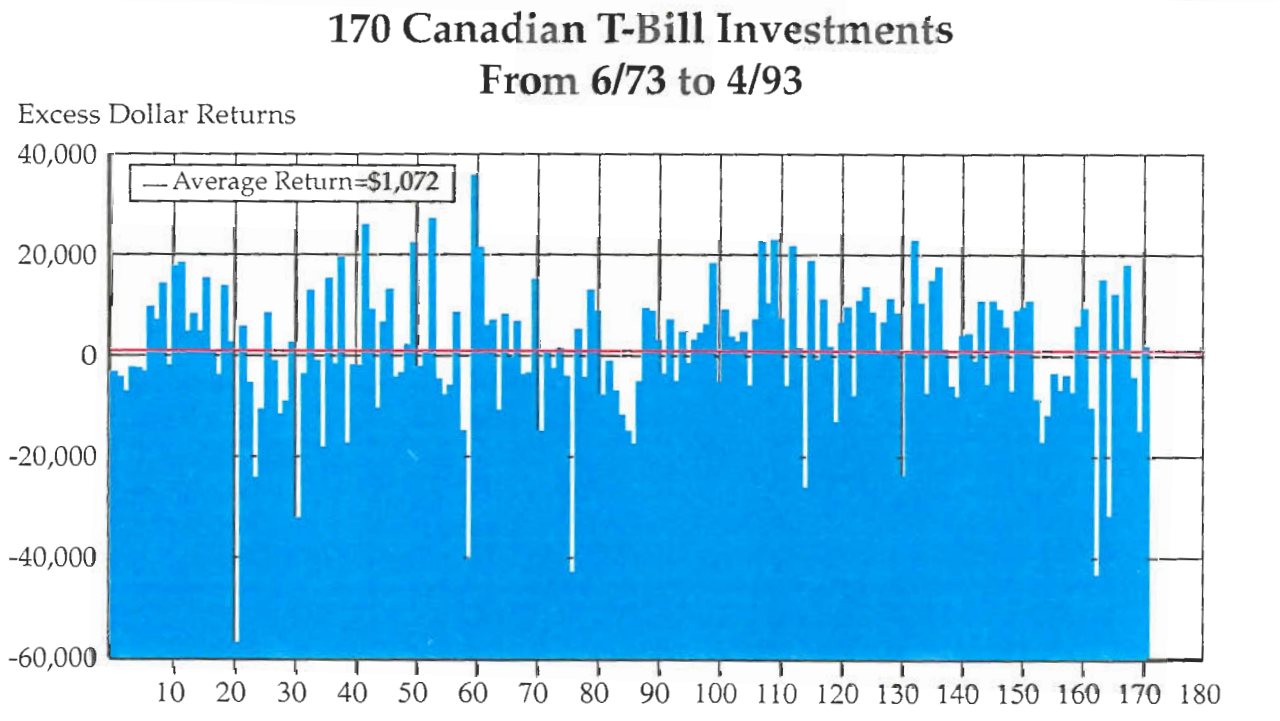
Spot and Forward Exchange Rates. The behavior of the forward exchange rate also challenges foreign exchange market efficiency. Before proceeding with this claim, however, a description of the forward and spot exchange rate markets is in order.[4] Suppose the date is September 1. If the spot exchange rate is 1 Canadian dollar per U.S. dollar, on September 1 the investor could exchange 1 Canadian dollar for 1 U.S. dollar. Similarly, on September 1 an investor can lock into an exchange rate, called the one-month forward exchange rate, for a transaction that will occur one month from that day. For example, an investor might be able to buy the Canadian dollar in the forward market at the forward exchange rate of 2 Canadian dollars per U.S. dollar on September 1. The forward exchange rate is agreed to and known on September 1, but no money changes hands. One month from that day, however, the investor is obligated to trade 1 U.S. dollar for 2 Canadian dollars.

[2]This result has been shown empirically to be generally true for the currencies of the major industrial countries. See for example Froot (1990).

[3]For a summary of the evidence against foreign exchange market efficiency, see Hodrick (1987).

[4]For exposition, the description of the spot and forward exchange rate markets has been simplified. The actual rules governing these markets are slightly more complicated. For a more detailed description, see Grabbe (1991).

FIGURE 1



In an efficient market, risk-neutral investors should set the one-month forward exchange rate equal to what they expect the spot exchange rate to be one month in the future.[5] Otherwise, the market would be allowing exploitable profit opportunities. For example, suppose on September 1 that investors expected the one-month-ahead spot exchange rate to be 1 Canadian dollar per U.S. dollar, but the market set the one-month forward exchange rate to be 2 Canadian dollars per U.S. dollar. Then, the market would be allowing an obvious profit opportunity. On September 1, an investor could enter a one-month forward contract to sell U.S. dollars in exchange for Canadian dollars. One month later, the investor could execute the forward contract by delivering 1 U.S. dollar in exchange for 2 Canadian dollars. Then, if the spot exchange rate on October 1 turned out to be 1 Canadian dollar per U.S. dollar as expected, the investor could sell his 2 Canadian dollars for 2 U.S. dollars in the spot market. The investor would then have made a $1 return, since he turned $1 into $2. However, if the market had set the one-month forward rate to be 1 Canadian dollar per U.S. dollar, and the spot exchange rate on October 1 turned out to be 1 Canadian dollar per U.S. dollar as expected, no return would have been possible.

Since expectations about a specific event usually prove incorrect, we cannot rule out extra returns in any particular month, even if the foreign exchange market is efficient. Suppose that on September 1 the one-month forward exchange rate is set to equal the expected one-month-ahead spot exchange rate of 1 Canadian dollar per U.S. dollar. But on October 1, expectations are proved wrong: the Canadian dollar exchanges for 1.25 U.S. dollars. Had an investor bought the Canadian dollar in the forward exchange market on September 1, he would have made a $0.25 return on October 1. So, in months when the Canadian dollar turned out to be worth more than expected in terms of the U.S. dollar, investors would earn extra returns. In months when the Canadian dollar turned out to be worth less than expected in terms of the U.S. dollar, investors would incur losses. As long as expectations were correct on average, over many months the positive extra returns would cancel out the negative ones and no net extra return would be earned. The market would be efficient even though extra returns appeared randomly in some months.

Biased or Unbiased Predictor? The distinct notions that the market is efficient and that expectations are correct on average can be combined in a single idea: the one-month forward exchange rate should be an unbiased predictor of the one-month-ahead spot exchange rate. In any month, the forward exchange rate in an efficient market will be the same as the market's estimation of the one-month-ahead spot exchange rate. Thus, the forward exchange rate will predict the one-month-ahead spot exchange rate. If expectations are correct on average, the forward rate prediction may not be correct in any particular month but, on average, ought to be correct. In some months, the forward exchange rate will predict a one-month-ahead spot exchange rate that is too high, and in other months, one that is too low. If the predictions are correct on average, the high predictions should cancel out the low predictions, so that the prediction will not be biased either on the high side or on the low side. Consequently, economists claim that the forward exchange rate will be an unbiased predictor of the one-month-ahead spot exchange rate when markets are efficient and expectations are correct on average.

Looking at the data on forward and spot exchange rates, however, casts some doubt on

[5] A risk-neutral investor does not need to be compensated for bearing the risk that the one-month-ahead spot exchange rate may turn out to be different from expectations. Risk will be more fully discussed in the section "Time-Varying Risk Premia."

the joint hypothesis that the market is efficient and expectations are correct on average. It turns out that the forward exchange rate is not an unbiased predictor of the one-month-ahead spot exchange rate, a fact illustrated by looking at the historical relationship between the one-month forward and one-month-ahead spot Canadian dollar-U.S. dollar exchange rates for the period June 1973 to April 1993 (Figure 2). If the forward exchange rate were an unbiased predictor of the one-month-ahead spot exchange rate, the forward exchange rate should fluctuate randomly around the one-month-ahead spot exchange rate. In that way, the forward exchange rate would overpredict the one-month-ahead spot exchange rate as often as it underpredicts it. However, the forward exchange rate for Canadian vs. U.S. dollars does not tend to fluctuate randomly around the one-month-ahead spot exchange rate, but rather tends to stay below the spot rate for extended periods when the spot rate is rising and to stay above the spot rate for extended periods when the spot rate is falling (Figure 2). The one-month forward exchange rate is therefore a biased predictor of the one-month-ahead spot exchange rate.

FIGURE 2

One-Month Forward Rate vs. One-Month-Ahead Spot Rate

(Actual)

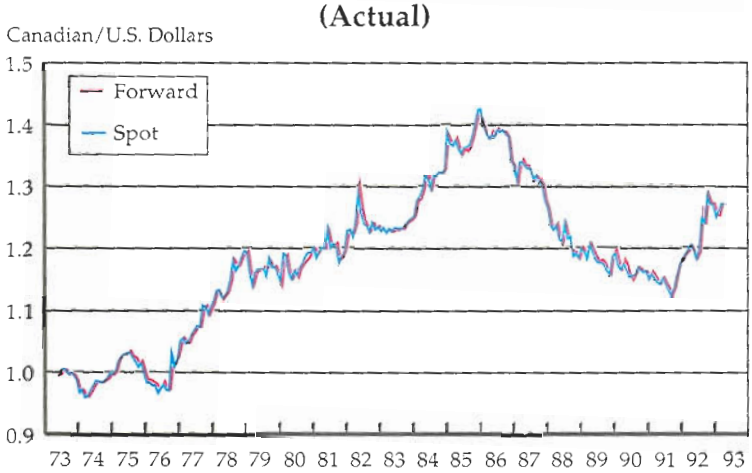
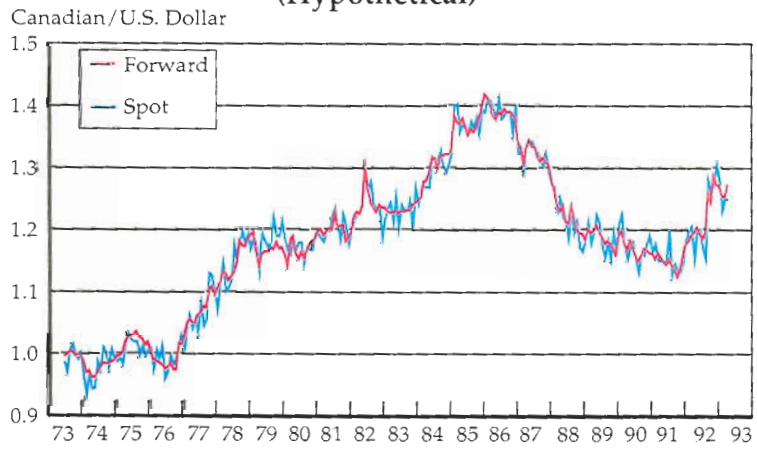


FIGURE 3

One-Month Forward Rate vs. One-Month-Ahead Spot Rate

(Hypothetical)



Contrast this behavior with an unbiased predictor I have constructed (Figure 3).[6] Notice that sometimes the forward rate underpredicts and other times it overpredicts the future spot exchange rate. But it does not systematically over- or underpredict the future exchange rate as a biased predictor would.

That the forward exchange rate is a biased predictor of the one-period-ahead future spot exchange rate suggests that the foreign exchange market may not be efficient and that it may be possible to earn extra returns. Howev-

[6]The artificial one-month-ahead spot exchange rate series was constructed by adding to each actual U.S. dollar-Canadian dollar forward exchange rate in the series the realization of an independent and identically distributed standard normal random variable.

er, economists are not convinced that forward exchange rate bias proves that the foreign exchange market is inefficient. Consequently, they have constructed explanations that allow for the bias of the forward exchange rate while at the same time maintaining market efficiency.

SOME EXPLANATIONS FOR SEEMING MARKET INEFFICIENCY

Statistical Problems. A problem that plagues the study of foreign exchange market efficiency is that the one-month forward exchange rate may be a biased predictor of the one-month-ahead spot exchange rate, even though the market is efficient. This can happen when investors expect an event that has not yet occurred to affect future exchange rates.

A real-world example of this problem concerned the behavior of the Mexican peso in the early 1970s. At that time, the Mexican government fixed the spot dollar-peso exchange rate at a constant value; however, it was widely expected that sometime in the near future the government would devalue the peso—that is, change the rate so that the peso would be worth less in terms of the dollar. Consider the situation before the government changes the fixed exchange rate. When investors form expectations of the one-month-ahead spot exchange rate, they have to take into account the chance that the government might devalue the peso. Thus, investors expect the peso to be worth less in one month than it is today, even though the spot exchange rate is currently fixed. In an efficient market, then, risk-neutral investors will set the peso in the one-month forward market to be worth less in terms of the dollar than it would be at the current fixed rate. Therefore, until the government changes the fixed exchange rate, the one-month forward exchange rate will be a biased predictor of the one-month-ahead spot exchange rate, even if the market is efficient.

It would be a mistake, then, to conclude that because the forward exchange rate is a biased predictor of the one-month-ahead spot exchange rate, the market must be inefficient. This may merely indicate that investors expect an event that has not yet occurred to affect the future exchange rate. International economists—quite naturally—call this kind of statistical problem a peso problem.

Failure of Rational Expectations. The proposition that expectations are correct on average is called rational expectations by economists. The assumption of rational expectations pervades not only international finance but also most branches of economics. Although it has been described implicitly both in the bill-investing example and in our discussion of the forward exchange rate market, it may be useful to explain it in a simple context.

Suppose you play a game in which you flip a fair coin. If heads comes up, you win $3. If tails comes up, you lose $1. Clearly, the average value you would win over time is $1, since half the time you win $3, and half the time you lose $1 [($3 x 1/2) - ($1 x 1/2) = $1]. So, if you expect to win $1 on average, you have rational expectations, since your estimate of the average value of the winnings is indeed its actual average value. But if you expect to win $2 on average, you do not have rational expectations.

The assumption of rational expectations seems plausible. However, verification of rational expectations is difficult, since people's expectations are not directly observable. Typically, researchers have attacked this problem indirectly by using surveys of expectations to represent true market expectations. For example, in a 1987 study, Jeffrey Frankel and Ken Froot provided evidence indicating that investors in the foreign exchange market may not have rational expectations. Using survey data of predictions made by private exchange-rate forecasters, they found that forecasters make biased predictions of future exchange rates.[7]

[7]This may also indicate a peso problem.

Of course, not all economists accept their results, since they rely on survey data that may not properly reflect true market expectations.

Whether the lack of rational expectations explains the seeming failure of market efficiency is certainly controversial. Many economists find it hard to believe that people do not possess rational expectations, since this implies that investors do not learn from their mistakes but continue to make them systematically. To illustrate the point, let us return to our coin-flipping game. Imagine the following investment. A broker offers investors the chance to play a game in which the investor can win $3 or lose $1. The investor may play the game as often as he likes, but he is not permitted to know that the broker is flipping a coin to decide whether he wins $3 or loses $1. At this point, the investor cannot have rational expectations, since he does not know about the coin. However, if the investor played the game many times and saw the pattern, he would then be able to estimate the average winnings even if he never saw the coin. He may misestimate the average winnings at first, but he would not likely continue to do so.

Many economists believe that investors in the foreign exchange market develop rational expectations in the same way. Investors have a great incentive not to make systematic mistakes in estimating future exchange rates, since failure to do so can lead to large losses. The absence of rational expectations could well explain the seeming failure of foreign exchange market efficiency, but many economists are reluctant to discard the notion of rational expectations given its inherent plausibility.

Time-Varying Risk Premia. A third potential explanation for the seeming failure of efficiency in the foreign exchange market is the possibility of time-varying risk premia. Since the one-month forward exchange rate is a biased predictor of the one-month-ahead spot exchange rate, extra returns seem to be available in the foreign exchange market. But these extra returns may simply be compensation for bearing risk. In the discussion of the bill-investment example and of the forward exchange rate market, we made a crucial assumption: the investor is risk-neutral, which means he does not need to be compensated for taking risk. However, any exchange rate investment in which future exchange rates are uncertain involves exchange rate risk, risk for which a risk-averse investor must be compensated.

Before returning to our example of the Treasury-bill investment, it may be useful to explain the concepts of risk neutrality and risk aversion in the context of our coin-flipping game. Recall that if heads turns up, the investor wins $3. If tails comes up, the investor loses $1. On average, the investor wins $1 playing this game. What is the most an investor would pay each time to play this game? The answer depends on his attitude toward risk. On average the investor stands to win $1 per coin toss, but for any particular toss of the coin, he bears the risk of losing $1. Even if the investor tosses the coin 10 times, he cannot be sure of winning the $1 average return; he may have a run of bad luck. If the investor is risk neutral, he does not need to be compensated for bearing risk. In this case, he would be willing to pay up to $1 to play this game, since that is the average winnings. If he is risk-averse, he must be compensated for bearing risk. Therefore, he would pay, at most, something less than $1 to play this game. The risk premium is the amount that the investor must be compensated for bearing risk.

Suppose the risk-averse investor paid $.75 to play this game. Since the average winnings ($1) in this game exceed the cost to play ($.75), it would seem that a return of $.25 is available. But it would be wrong to conclude that the market for coin-flipping games is inefficient; rather, the $.25 is not a profit opportunity, but compensation for bearing risk.

The situation is much the same in our bill-investment example. A Treasury bill denominated in U.S. dollars represents a claim on the

consumption of U.S. goods, since it is ultimately worth a certain amount of U.S. dollars upon maturity. Similarly, a bill denominated in Canadian dollars represents a claim on consumption of Canadian goods. Since Canadian dollars can be converted to U.S. dollars, and vice versa, a U.S. bill is also a claim on Canadian consumption, and a Canadian bill is a claim on U.S. consumption. But the magnitude of these claims is uncertain: when a U.S. bill is redeemed for U.S. dollars, how much U.S. or Canadian goods these U.S. dollars will buy cannot be predicted with certainty. That depends on the exchange rate, which is uncertain, and the prices of U.S. and Canadian goods when the bills are redeemed. Thus, U.S. and Canadian bills are risky assets, even though there's no risk that the governments that issued them will fail to pay investors when the bills mature.

If an investor is risk-averse, he will require a risk premium to compensate him for holding the riskier bill. If Canadian Treasury bills are judged riskier than U.S. bills, Canadian bills must pay a higher return than U.S. bills. Conversely, if U.S. bills are the riskier assets, they must pay a higher return than Canadian bills. Let's go back to our first example: suppose the annual interest rate on the Canadian bill is 1 percentage point higher than that on the U.S. bill. If risk were not compensated, on average the Canadian dollar should turn out to be worth 1 percent less on an annual basis in terms of the U.S. dollar. In that way, the return to holding U.S. bills or Canadian bills is the same. However, suppose we discover that the Canadian dollar turns out on average to be worth 1 percent more in terms of the U.S. dollar on an annual basis. According to the risk premium hypothesis, one interpretation of this situation is that investors are risk-averse. Since the Canadian dollar turns out, on average, to be worth 1 percent more in terms of the U.S. dollar on average, the investor is being paid a 2 percent premium for holding the Canadian bill: he receives a 1 percent capital gain on the Canadian dollar, and he also receives an interest rate 1 percentage point higher than that on the U.S. Treasury bill. Therefore, under the risk premium hypothesis, our interpretation is that Canadian Treasury bills are riskier than U.S. bills, and investors are being paid a 2 percent risk premium to induce them to hold Canadian bills.

The risk premium on Canadian Treasury bills can also be negative. Suppose annual interest rates on U.S. Treasury bills are 1 percentage point higher than those on Canadian bills, and we observe that the U.S. dollar turns out on average to be worth 1 percent more on an annual basis. Then the investor is giving up 2 percent in additional returns to hold the Canadian T-bill: the 1 percent in interest he would have earned on the U.S. T-bill and the 1 percent capital appreciation of the dollar. Under the risk premium hypothesis, the Canadian T-bill is seen as safer than the U.S. T-bill. Because Canadian T-bills are less risky, investors must give up 2 percent in returns in order to hold them. In this case, the risk premium on the Canadian T-bill equals -2 percent.

The risk premium on the Canadian T-bill, then, tends to be positive when Canadian T-bill interest rates exceed those on U.S. T-bills and tends to be negative when interest rates on U.S. T-bills exceed those on Canadian T-bills. Since the interest rate on U.S. T-bills frequently moves above and below the Canadian T-bill rate, the risk premium, if one exists, must frequently vary between positive and negative values. It is in this sense that economists speak of time-varying risk premia.

Risk premium explanations, although plausible, are hard to square with recent economic history. For example, during the mid-1980s, U.S. interest rates were consistently above the interest rates of many foreign countries. Over the same period, the dollar gained in value at a rapid rate against these countries' currencies. Thus, the risk premium in U.S. dollar terms

seemed to be large and positive. If the risk premium explanation is true, U.S. dollar assets were seen as much riskier than foreign assets precisely at a time when common opinion held that the dollar was strong because the U.S. was a safe haven for investment. After 1985, despite the fact that U.S. interest rates remained above the interest rates of some foreign countries, the dollar lost value at a rapid rate against these countries' currencies. Thus, the risk premium seemed to become negative, meaning U.S. assets were seen as safer than foreign assets. What produced such a dramatic change? Looking back on the history of the 1980s, it's difficult to point to specific events that may account for these swings in the riskiness of U.S. or foreign bills. (See *Testing for a Time-Varying Risk Premium* for more about risk premia.)

FILTER RULE STUDIES

Another strategy for earning extra returns in the foreign exchange market recommended by some economists is a so-called filter rule. The idea is simple. Whenever a foreign currency is worth a certain percent more (like 1 percent) in U.S. dollar terms than its previous low, invest in foreign assets. Stay invested in those foreign assets until the foreign currency is worth a certain percent less than its previous high, then switch back into dollar assets.[8] In 1983, two economists, Michael Dooley and Jeffrey Shafer, showed that had an investor followed a 1 percent filter rule, he could have earned a fairly consistent return speculating in the major currencies.

Since these returns may have occurred by chance, Richard Sweeney, in 1986, tested whether filter rule profitability can reasonably be attributed to chance. He found that the returns made in filter rule strategies cannot be ascribed to luck and argues that filter rules indeed may provide excess returns, even when transactions costs are accounted for. Sweeney's tests, however, assume that the risk premium is constant. If the risk premium is time-varying, then even if the returns do not occur by chance, they may not be evidence against market efficiency. With time-varying risk premia, the filter rule

[8]The reader who is familiar with the investment literature may recognize this as a form of technical analysis.

Testing for a Time-Varying Risk Premium

Economists have tried to find statistical evidence for the existence of time-varying risk premia, but they have reached no firm conclusions. Typically, they have specified and tested an economic model of investment in the foreign exchange market. A popular economic model, much used by academics and practitioners alike, is the capital asset pricing model (CAPM). The CAPM relates the risk premium to the difference between expected return on the market portfolio of securities and the risk-free rate of interest. Mark (1988) and Hopper (1993) tested the CAPM to see if time-varying risk premia explained the fact that the one-month forward exchange rate is a biased predictor of the one-month-ahead spot exchange rate. Mark (1988) found results favorable to the risk premium hypothesis, but Hopper (1993) found evidence against it.

A related model, popular among economists, is the consumption CAPM. Unlike the standard CAPM, where investors are postulated as making only investment decisions, under a consumption CAPM, investors are also hypothesized as making consumption decisions too. Mark (1985) and Kaminsky and Peruga (1990) tested the consumption CAPM and reported results somewhat favorable to the risk premium hypothesis, but not conclusively so. Hopper (1993) tested a version of the consumption CAPM, but found evidence against the model. In general, most international financial economists believe that more evidence must be accumulated before the risk premium hypothesis can be fully accepted.

could merely be putting the investor into the foreign asset when the risk is high and taking him out when the risk is low. Thus, if there are time-varying risk premia, the returns found in filter rule studies would be compensation for bearing risk and would not be excessive on a risk-adjusted basis.

IMPLICATIONS OF THE ANALYSIS

The reader who has progressed this far might well feel somewhat disappointed with the analysis. The investor or corporate treasurer wants to know whether extra returns can be made if the foreign exchange market is inefficient. Is the foreign exchange market inefficient? On the one hand, excess returns seem to result from following simple rules. On the other hand, the returns may be explained by a peso problem, the failure of rational expectations, or time-varying risk premia. It's possible that these phenomena may be present in the foreign exchange market, but the evidence is far from conclusive. Thus, at present, the best answer economists can give to the question of market inefficiency is—maybe.

How can this help the investor or corporate treasurer? Economists may not be able to show investors how to make money in the foreign exchange market, but they do know enough to help investors avoid losing money. The insights gained by economists who study foreign exchange market efficiency can be used to assess proposed investment strategies. To see how, let us consider a final example.

Suppose once again you are responsible for managing investments for your company. An investment consulting company approaches you with a proposition. The proposition involves not a simple filter rule, but rather a complex rule involving arcane mathematics. The consulting company shows that had their rule been followed during the past 10 years, a 20 percent average annual rate of return would have resulted. Moreover, clients who have actually used the rule over the past year have continued to earn a 20 percent annual rate of return. Should you use the rule? The analysis in this article suggests some questions that can guide your decision.

First, what is the time-varying risk in following the strategy? After all, the complicated mathematics in the rule might merely be instructing the investor to invest in very risky assets at each point in time. If this were the case, it would not be surprising to find a large average return. But the return would be at the expense of assuming higher risk. Thus, the rule is valuable only if it earns returns above what it should earn when risk is accounted for. It's not enough, then, for the consulting company to claim a 20 percent average annual rate of return. The consulting company must show that the returns are above normal on a risk-adjusted basis, that is, the consulting company must have a plausible model of time-varying risk premia.

Second, could a peso problem account for the rule's profitability? As we have seen, returns may appear to be available if investors expect an event that has not yet occurred. If a peso problem exists, an investor following a rule may make money before the event occurs but would lose it after the event occurs. Thus, if the market widely expects an event that has not yet occurred (such as a country withdrawing its currency from the European Exchange Rate Mechanism), a peso problem must be suspected when a technical trading rule seems to offer excess returns.

CONCLUSION

An investor can earn extra returns by always investing in the short-term government securities of the major industrial country that pays the highest interest rate, although the risk to such a strategy will be high; moreover, the forward exchange rate is a biased predictor of the future spot exchange rate. Economists are at present undecided whether these facts should be interpreted to mean that the foreign ex-

change market is inefficient. A peso problem might explain why the forward exchange rate is a biased predictor of the future spot exchange rate. Alternatively, if investors do not have rational expectations or if there are time-varying risk premia, the foreign exchange market may still be efficient. Some survey evidence supports the claim that investors do not have rational expectations, but such evidence is not convincing to many economists, since surveys may not reflect true expectations of investors in the market. There is also some favorable evidence on the existence of time-varying risk premia, but the models are open to statistical dispute.

Because the foreign exchange market may well be inefficient, extra returns that cannot be explained by the assumption of greater risk might be earned in the foreign exchange markets. By employing filter rule strategies, the investor can earn above normal returns that do not appear to be attributable to chance. Whether these returns are truly evidence of market inefficiency or are merely compensation for bearing risk remains an open question.

Answering this question is important not only for economists but also for practitioners in the foreign exchange markets. Given the inconclusive nature of the literature and the possibility that the foreign exchange market is inefficient, investors cannot be sure whether they are forgoing extra returns in the foreign exchange market. How the literature on foreign exchange market efficiency will progress cannot be predicted, but investors have a practical incentive to follow its development.

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