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Anomalies
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Kenneth A. Froot and Richard H. Thaler

Economics can be distinguished from other social sciences by the belief that most (all?) behavior can be explained by assuming that agents have stable, well-defined preferences and make rational choices consistent with those preferences in markets that (eventually) clear. An empirical result qualifies as an anomaly if it is difficult to "rationalize," or if implausible assumptions are necessary to explain it within the paradigm. This column will present a series of such anomalies. Readers are invited to suggest topics for future columns by sending a note with some reference to (or better yet copies of) the relevant research. Comments on anomalies printed here are also welcome. The address is: Richard Thaler, c/o *Journal of Economic Perspectives*, Johnson Graduate School of Management, Malott Hall, Cornell University, Ithaca, NY 14853.

Introduction

The one person in your family who ever asks your advice about economics is your uncle, who is in the import-export business. A while back he called you about a foreign exchange issue. "Let's suppose I owe a million German marks, payable in one month." he said. "We have the money to pay the bill in dollars, so the issue is whether to put the money into marks now or later. I figure we should put the money wherever it would earn the highest rate, but my treasurer, one of those MBA hot shots, tells me that this is irrelevant because if

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the interest rate is high in Germany that means that the mark is expected to go down. When I ask her what we should do, she says that it doesn't matter. 'Flip a coin,' she says! Is this what I am paying her so much money for? To flip coins?" You tried to calm your uncle down, and explain the idea of efficient markets to him, but he was unconvinced. "OK," you told him, "if you think you can do better, why don't you run an experiment. You invest some of your money your way, while your treasurer flips coins, and then see who does better." He thought this was a great idea, and promised to let you know what happens.

Much to your surprise, your uncle called back recently. He claims to have a strategy that beats his coin-flipping treasurer. "Here's what I do," he crowed. "When interest rates rise in other countries I put my money there, and take my chances on the currency falling. On the other hand, if rates in the foreign country fall relative to U.S. rates, I keep my money here. It's simple, I admit, but it seems to be working. Of course, my treasurer claimed it was just luck, and said she would do some testing with historical data to prove her point. Well, she just came sheepishly into my office with piles of computer output and has agreed my theory beats her coin flipping. What do you think of this, wise guy?" Baffled, you decide to look into the literature on foreign exchange rates.

* * *

The foreign exchange market is among the most active of all financial markets. As of mid-1989, the average volume of trading activity (adjusted for double counting) was about $430 billion per *day*. To get a sense for just how big this number is, consider that daily U.S. GNP is about $22 billion, and daily world trade in goods and services is about $11 billion. Since foreign exchange trading is so much greater in volume than is trade in real goods and services, foreign exchange markets would seem to be highly liquid and efficient.

Partly as a result of the sheer volume of trading, many researchers have focused on the foreign exchange market to examine questions of speculative efficiency. One view—argued initially by Friedman (1953)—is that because speculators buy low and sell high their activity ensures that exchange rates reflect the fundamental or long-run determinants of currency values. A second strand of literature, often attributed to Nurske (1944), holds that speculation in foreign exchange can be destabilizing, and that excess volatility imposes large costs on producers and consumers who as a consequence makes less efficient allocative decisions.

Recently this debate has escalated, as both sides try to come to grips with the dramatic, *temporary* 65 percent appreciation in the value of the dollar during the mid-1980s.[1] Some hold that these swings in the dollar's value were attributable to changes in fundamentals, and that given those fundamentals the appreciation was both predictable and optimal. Others, however, point to the

[1]For a discussion of the performance of exchange rate models over this period, see Meese (1990).

experience as evidence of a capricious delinking of the dollar from its usual determinants, and argue that at least some of the dollar's appreciation could have been prevented beneficially. The debate about whether exchange rates are "correctly priced" is particularly important (in comparison to similar debates about the pricing of other assets) since the exchange rate simultaneously affects the prices of all foreign assets, goods, and factors of production. If Nurske's followers are right that speculation drives prices away from fundamentals, then the argument for intervention might be considered strongest in the market for foreign exchange.

In what follows, we discuss the efficiency of foreign exchange markets. Readers interested in more complete treatments should refer to Mussa (1979), Levich (1985), Boothe and Longworth (1986), Hodrick (1987), and Froot (1990). To manage what would otherwise be an enormous task, the question of efficiency is viewed below from the perspective of a single type of test: the test for what is called the forward discount bias. This test is easy to understand, and since it strongly rejects the null hypothesis, statistical power is not an issue. Naturally, in discussing this particular test we mention a variety of other empirical work designed to shed light on alternative explanations of the results.

Tests of Forward Discount Bias

If investors are risk neutral and have rational expectations, then the market's forecast of the future exchange rate is implicit in international differences in interest rates. To see this, suppose that the one-year dollar interest rate is 10 percent, and that the comparable German mark interest rate is 7 percent. The dollar interest differential is then said to be 3 percent. Risk neutral, rational investors then must expect the dollar to depreciate against the mark by 3 percent over then next year. This amount of depreciation would be just enough to equalize the expected returns on dollar and mark denominated deposits. If instead these investors expected a different rate of dollar depreciation, say 4 percent, they would all wish to borrow in dollars and lend in marks. Consequently, dollar interest rates would tend to rise and mark interest rates would tend to fall until the interest differential also became 4 percent. This simple relationship between interest differentials and expected currency depreciation is called uncovered interest parity (uncovered because forward markets are not used as a hedge). Thus, uncovered interest parity implies that the interest differential is an estimate of the future exchange rate change. If expectations are rational, then this estimate of future exchange rate changes provided by the interest differential should be unbiased.

Unbiasedness is usually tested by regressing the change in the exchange rate on the interest differential,

$$\Delta s_{t+k} = \alpha + \beta(i_t - i_t^*) + \eta_{t+k}, \tag{1}$$

where Δs_{t+k} is the percentage depreciation of the currency (the change in the log of the spot dollar price of foreign exchange) over k periods and $(i_t - i_t^*)$ is the current k-period dollar interest rate less the k period foreign interest rate. The null hypothesis is that $\beta = 1$. Some authors include $\alpha = 0$ in the null hypothesis as well. In other words, the realized depreciation of the spot rate is equal to the interest differential plus a purely random error term, η_{t+k}.

A second specification of equation (1) replaces the interest differential by the forward discount; that is, the percentage difference between the current forward and spot exchange rates. (The forward rate is today's dollar price of foreign exchange to be delivered on a specific date in the future.) By arbitrage, the forward discount must equal the interest differential. If it did not, then a strategy of borrowing in the foreign currency, changing the proceeds into dollars, investing those dollars and then selling them forward would yield a riskless profit. Most observers agree that the market respects this arbitrage condition, as banks allow forward rates to be set by interest differentials. Under risk neutrality and rational expectations, the forward discount should also be an unbiased estimate of the subsequent exchange rate change. Indeed, the failure of regressions such as (1) to yield estimates of $\beta = 1$ is often referred to as the forward discount bias.

A very large literature has tested the unbiasedness hypothesis and found that the coefficient β is reliably less than one. In fact, β is frequently estimated to be less than zero. The average coefficient across some 75 published estimates is -0.88 (Froot, 1990). A few are positive, but *not one is equal to or greater than the null hypothesis of* $\beta = 1$.

A coefficient of approximately minus one is difficult to explain. It implies that, for example, when U.S. interest rates exceed foreign rates by one percentage point, the dollar subsequently tends to appreciate at an annual rate of one percent. This is in contrast to the one percent depreciation dictated by the unbiasedness hypothesis.

Two interpretations of these results are common in the literature. Some authors argue that $\beta < 1$ is evidence of a time-varying risk premium on foreign exchange: when the dollar interest rate rises, investments in dollar assets become relatively more risky.[2] Alternatively, others assume that exchange rate risk is purely diversifiable or that investors are risk neutral. They therefore interpret any bias as evidence of expectational errors. The next two sections evaluate the merit of these two types of explanations.

Exchange Risk Premia

If investors in foreign exchange markets are risk averse, and if foreign exchange risk is not fully diversifiable, then the interest differential or forward

[2] Similarly, the results would then also imply that when the foreign interest rate rises (relative to the dollar interest rate), investments in foreign assets become relatively more risky.

discount can no longer be interpreted as a pure estimate of the expected change in future exchange rates. Rather, the interest differential is the sum of the expected change in the exchange rate plus a risk premium. Thus, if the dollar is viewed as riskier than the foreign currency, dollar interest rates would have to be higher, even if the exchange rate is not expected to change. If the assumption of rational expectations is maintained, then a finding of $\beta \neq 1$ implies that interest rate movements are related to changes in the risk premium. In particular, a finding of $\beta < 1$ implies that a 1 percent increase in the dollar interest differential is associated with a less than 1 percent expected drop in the value of the dollar. Since the risk premium is just equal to the interest differential less the expected change in exchange rates, this implies that the risk premium on dollar assets must rise with the interest differential, or equivalently, the required return on foreign exchange must fall.[3]

Naturally, a finding of $\beta < 0$ is more extreme: an increase in the interest differential is then associated with a *decline* in expected depreciation (since the dollar subsequently appreciates on average) and therefore with an even larger rise in the risk premium. As Fama (1984) pointed out, this implies that the variance of the risk premium is greater than the variance of both expected depreciation and the interest differential, and that the covariance of expected depreciation and the risk premium is negative.

By itself, a negative correlation between expected depreciation and the risk premium might be considered plausible: higher expected inflation in the United States might sensibly be associated with both greater expected dollar depreciation and increased riskiness of dollar-denominated assets (Hodrick and Srivastava, 1986). This would be the case if, for example, higher expected inflation reflects greater uncertainty about the future course of monetary policy. The real problem for explanations based on risk premia is whether they can explain why a change in interest rates should produce an even larger change in risk premia. Three approaches have been advanced to evaluate the merit of the risk-premium interpretation—none of which offer the hypothesis much support.

The first approach specifies and tests what one might call "statistical" models of risk. Rather than exploring whether underlying economic determi-

[3]Readers may find it difficult to understand how assets denominated in one currency can be riskier than assets denominated in the other currency when there is only a single exchange rate to connect them. The following example may help. Suppose that two equally-sized countries have perfectly integrated trade in goods and assets. Each produces its own good, but consumes both goods in equal amounts. Each country also has an asset which pays off in future consumption of its good. Now suppose that country *A*'s asset represents claims to a greater fraction of country A's good than B's asset represents of country B's good. In other words, the outstanding supply of country A's asset is larger than country B's. Since investors will consume the same amount of each good, all else equal, they will want to invest half of their portfolio in the assets of each country. Investors will agree to hold a greater fraction of their portfolio in the assets of county A—as they must in equilibrium—only if they get paid a premium on the return of A's asset relative to B's. In such a case, we would say that assets denominated in A's goods are "riskier" than those denominated in B's.

nants of risk can help explain excess returns on foreign exchange, this approach tests for certain patterns in or across excess currency returns. While this class of tests has provided rich information about the predictable components of exchange rate changes, it has not provided much evidence that these components are actually attributable to risk. Another statistical test asks whether predictable returns can be explained by the expected variance in future returns. This kind of test may, in principle, be more able to distinguish between risk and expectational errors. In practice, however, there is no evidence that measures of expected variance are related to the forward discount bias. Domowitz and Hakkio (1985) present evidence that one such measure of expected future variance, computed using a model of autoregressive conditional heteroskedasticity (ARCH), is uncorrelated with the forward discount's bias.[4]

A second strand of tests for the exchange risk premium looks beyond relative asset returns themselves and examines various specifications of the fundamental determinants of required returns. One approach, taken initially by Frankel (1982), notes that the capital asset pricing model (CAPM) requires an asset's risk premium to be systematically related to that asset's value share in investors' portfolios. His tests provide no evidence that required returns are positively related to systematic risk in exchange rates. Indeed, using these models it is not possible to reject the hypothesis that the systematic risk is zero; that is, that the exchange risk premium is zero. There is no evidence here that risk premia vary in a way that can explain predictable excess returns in foreign exchange (Frankel and Engel, 1984; Hodrick, 1987). Later work has examined more complex models of time-varying risk, but with similar results (Engel and Rodrigues, 1989; Giovannini and Jorion, 1989; Mark, 1985; Obstfeld, 1990).

The third approach for assessing the risk-premium interpretation attempts to measure expected depreciation directly, thereby avoiding reliance on inferences from realized depreciation. If one could actually observe expectations it would be possible to decompose the interest differential's bias into separate components attributable to risk premia and to expectational errors. This would not tell us how the risk premium is formed, but it could tell us the importance of risk and market efficiency in explaining the bias.

The problem, of course, is that market expectations are not observable. However, by gathering independent measures of expectations, one might nevertheless hope to gain insights. Froot and Frankel (1989) use survey data on the expectations of foreign exchange traders as their independent measure of expected depreciation. If the survey expectations are accepted as a measure of expected depreciation, then the bias in the interest differential can be decomposed into a risk premium and a bias in expectations. When this decomposition

[4]Another statistical model of exchange rate changes is presented by Engel and Hamilton (1990). They find evidence of "long swings" in the exchange rate and can reject the hypothesis that the exchange rate follows a random walk, but are also unable to find any correlation between their model's predictions and the forward discount's bias.

is performed, the component attributable to risk turns out to be small and insignificantly different from zero. This is not to say that the surveys don't contain a risk premium, as would be true if the surveys were always equal to the interest rate differential. In fact, the risk premia implied by the surveys are substantially different from zero and move over time. However, these survey risk premia are uncorrelated with the forward discount.

Finally, we might put the alternative hypothesis of a time-varying risk premium to a more informal sensibility check, asking how it would explain the unprecedented behavior of the dollar in the 1980s. From late 1980 until early 1985, dollar interest rates were above foreign rates so the dollar sold at a forward discount, implying that the value of the dollar should fall. However, the dollar appreciated (more or less steadily) at a rate of about 13 percent per year. Under the risk-premium scenario, these facts would suggest that investors' (rational) expectation of dollar appreciation was strongly positive (perhaps even the full 13 percent), but that the risk premium was also positive. Therefore, according to this view, dollar-denominated assets were perceived to be much riskier than assets denominated in other currencies, exactly the opposite of the "safe-haven" hypothesis which was frequently offered at that time as an explanation for the dollar's strength.

The subsequent rapid fall in the value of the dollar would conversely imply a reversal in the risk premium's sign, as investors in 1985 switched to thinking of the dollar as relatively safe. Something very dramatic must have happened to the underlying determinants of currency risk to yield such enormous swings in the dollar's value: during the appreciation investors must have been willing to give up around 16 percent per year (13 percent from dollar appreciation plus 3 percent from an interest differential in favor of the dollar) in order to hold the "safer" foreign currency, whereas during the later depreciation phase they must have been willing to forego about 6 percent in additional annual returns (8 percent average annual depreciation minus the 2 percent average interest differential) in order to hold dollars. These premia are very large. It is hard to see how one could rely on the risk-premium interpretation alone to explain the dollar of the 1980s.[5]

Expectational Errors

The other main alternative hypothesis is that expectational errors explain the bias in the forward discount and the interest differential. Under this alternative the risk premium is constant (or at least uncorrelated with the forward discount). It follows that an increase in the interest differential is

[5]These conclusions can be softened by arguing that investors were repeatedly surprised at the strength (and subsequent weakness) of fundamentals over this period. Rationally expected appreciation (and depreciation) and estimates of the risk premium would then be closer to zero than calculated above. We address such explanations directly in the next section.

associated with an equivalent increase in expected depreciation. Yet the print estimates above suggest that a 1 percent increase in the interest differential tends to be followed by a 1 percent appreciation in the value of the dollar. How could such expectational errors arise, and how could they persist?

Even if such expectational errors appear after the fact to be economically significant for the period studied, they may not imply that market inefficiency or unexploited profit opportunities existed beforehand. Perhaps the period studied was unrepresentative, in which case the usual methods of statistical inference may lead to incorrect conclusions. If investors are in the process of learning about floating exchange rates or other regime changes, then exchange rate changes will be affected by the learning. Lewis (1989) explores whether an explanation of this sort can explain the persistence of the 1980-85 dollar appreciation. She presents evidence that investors' slow learning about an unobservable shift in the U.S. money supply process can explain about half of the error implicit in the forward rate.[6] However, as Lewis notes, the errors do not seem to have died out over time, which is evidence against models of learning about once-and-for-all shifts in regime.

Another example which would generate misleading inferences from regressions is that of "peso problems." This term derives from the 1955–76 Mexican peso, which was fixed by the Mexican government at a constant rate against the U.S. dollar, yet all the while sold at a forward discount. Of course, the large depreciation apparently expected by investors did eventually occur, validating the prediction from interest rates and the forward market—but one could not have guessed this from the 1955–75 sample alone (Rogoff, 1979). In these as well as less extreme circumstances, peso problems will invalidate standard statistical inference procedures.

Michael Mussa has suggested why peso problems might indeed be expected to plague regressions of the type we have been discussing. He argues that the distribution of inflation rates is skewed: most of the time inflation hovers in a restricted range, but occasionally hyperinflation breaks out. For periods in which no hyperinflation actually occurs, increases in expected inflation overpredict the subsequent realized inflation rate. Since such increases in expected inflation are likely to be associated with increases in nominal interest rates and expected depreciation, the β coefficients will be less than one in more than half of the regression samples.

We can evaluate whether the peso problem is a reasonable explanation for the dollar of the early 1980s by using a skewness argument similar to that proposed by Mussa. During the 1980–85 period the dollar was above its 1980 level by an average of about 33 percent, and appreciated at an average annual rate of 13 percent. Suppose that the market did indeed expect the dollar to appreciate at 13 percent per year if it appreciated at all, but that the alternative

[6] See also Stulz (1986) for a model of learning about the money supply process.

was an expected collapse back to its 1980 level.[7] Expected depreciation would then be equal to the probability of collapse, π, times the average size of the expected collapse, 33 percent, minus the probability of appreciation, $1 - \pi$, times the amount of appreciation 13 percent. If we assume that expected depreciation was the 3 percent given by the interest differential, then the probability of collapse in any one year is: $\pi = (13 + 3)/(13 + 33) = 35$ percent. This would imply that the probability that the exchange rate went five years without collapsing was $(1 - \pi)^5 = .12$. If we take this computation seriously, the result suggests that the peso-problem hypothesis is unlikely to be true, although it cannot be rejected at standard levels of statistical significance.[8,9]

The bias in the interest differential seems less severe for certain types of fluctuations in interest rates. Tests of the bias during the buildup to hyperinflations, in which nominal interest rates move from being small to very large, show βs that are positive and nearer one. In addition, casual inspection of cross-sectional evidence suggests that interest differentials lead to reasonable predictions: high-inflation countries, such as Italy, typically have had higher nominal interest rates than the U.S., and their currencies indeed did tend to depreciate secularly. Just the reverse has been true for the currencies of low-inflation countries such as West Germany which has had relatively low interest rates. *In other words, the average level of the interest differentials points the right way in forecasting long-run currency changes, even though the short-run correlations usually point the wrong way in forecasting near-term exchange rate changes.*

Nevertheless, the preponderance of evidence that β is less than one across different subsamples, currencies, forecast horizons, and asset markets, coupled with the near rejection of the peso explanation of the behavior of the dollar in the early 1980s casts some doubt on the validity of learning and peso problems. To keep these explanations intact, one would need to argue that there is little independence across these many estimates of β. Perhaps there is the possibility of some important event that has not yet occurred—like complete nuclear annihilation—that somehow conditions investors' expectations in such a way as to create the appearance of bias. As the time-series and cross-sectional size of

[7]Some support for such skewness in investor's subjective distribution of exchange rate changes can be obtained from the prices of options on the dollar during this period. See Bates (1988) for evidence.

[8]This sort of calculation was performed originally by Dornbusch (1982), Frankel (1982) and Krugman (1989). The dollar's collapse could be thought of as coming from a discrete shift in policy, or from the bursting of a speculative bubble.

[9]The survey data discussed in Frankel and Froot (1987) report expected depreciation to be about 10 percent on average during this period, much larger than the interest differential which averaged about 3 percent. If we were to use this larger number in the above calculation, the probability of observing no collapse for five consecutive years falls to .03. That is, if investors expected more rapid dollar depreciation, it becomes easier to reject this peso problem argument. Keep in mind, however, a caveat about such casually formed test statistics: their size may overstate their true statistical significance because the 1980–85 subsample is not randomly drawn. See Evans (1986) for more formal methods.

the statistical sample continues to increase, however, such arguments become increasingly strained.

A Possible Explanation

The primary conclusions reached so far have been negative: a rational efficient markets paradigm provides no satisfactory explanation for the observed results. Perhaps the best we can do is to offer a simple and parsimonious explanation, one that has other testable restrictions but does not require full rationality of all investors. Consider as an example, the hypothesis that at least some investors are slow in responding to changes in the interest differential. It may be that these investors need some time to think about trades before executing them, or that they simply cannot respond quickly to recent information. These investors might also be called "central banks," who seem to "lean against the wind" by trading in such a way as to attenuate the appreciation of a currency as interest rates increase. Other investors in the model are fully rational, albeit risk averse, and even may try to exploit the first group's slower movements.[10]

A simple story along these lines has the potential for reconciling the above facts. First, it yields negative coefficient estimates of β as long as some changes in nominal interest differentials also reflect changes in real interest differentials. While changes in nominal interest rates have different instantaneous effects on the exchange rate across different exchange-rate models, most of these models predict that an increase in the dollar real interest rate (all else equal) should lead to instantaneous dollar appreciation. If only part of this appreciation occurs immediately, and the rest takes some time, then we might expect the exchange rate to appreciate in the period subsequent to an increase in the interest differential. Hence the possibility of a negative relationship between short-run changes in interest rates and exchange rates. Second, this hypothesis can also explain the cross-sectional and hyperinflation results, in which the interest differential correctly forecasts secular exchange rate changes. Short lags in the responsiveness of some investors would not affect the long-term relationship between interest differentials and exchange rate changes. A test of this hypothesis could be based on the additional implication that past (not just current) levels of the forward discount should help in predicting exchange rate changes. In fact, this hypothesis suggests that if past levels of the interest differential are added to equation (1), the estimated coefficient should be positive and near one. Froot (1990) presents evidence which is supportive of this latter implication.

Such an explanation (which stresses the lack of "efficiency" in the usual sense) seems to fit the facts well enough, but has an apparently serious flaw:

[10]For examples of such models see Cutler, Poterba, and Summers (1990) and Kyle (1985).

isn't there money to be made by trading on contemporaneous interest rate changes? The empirical case for foreign-exchange market efficiency was made forcefully by Bilson (1981). He argued that the speculative rule suggested by the finding of $\beta < 1$—buy the currency whose interest rate is relatively high—could actually provide expected profits without bearing much risk.[11]

Dooley and Shafter (1983) and Sweeney (1986) also examine several types of "filter rules:" trading strategies that are triggered by the past behavior of spot rates. A typical filter rule might specify that an investor should sell the dollar short if the dollar has appreciated by more than 2 percent the last 24 hours. Such rules appear profitable, although the profits are not always statistically significant. Also, Schulmeister (1987) and Cumby and Modest (1987) study a number of trading rules derived from technical analysis and find that these rules generate statistically significant profits.

Whether or not there is really money to be made based on the apparent inefficiency of foreign exchange markets, it is worth emphasizing that the risk-return tradeoff for a single currency is not very attractive. The annualized standard error of the regression estimates of equation (1) is about 36 percent. This implies that a strategy that generates expected profits of $1 comes with a standard deviation of profits of $15. To see this, note that with $\beta = -1$, a one percentage point increase in the dollar interest rate is associated with an additional two percent higher annual return on dollar assets than on foreign assets. On a monthly basis, a $500 investment therefore yields about $1 in expected profit, ($500 × .02)/12 ≈ $1—ignoring compounding. The standard error of profits is then ($500 × .36)/12 = $15. With transactions costs, the risk-return tradeoff becomes even less favorable. Although much of the risk in these strategies may be diversifiable in principle, more complex diversified strategies may be much more costly, unreliable, or difficult to execute.

Commentary

Anomalies in financial markets are often "explained" by economists with the use of some type of risk argument. For example, small firms which earn higher returns than large firms are said to be riskier, though differentials in traditional risk measures such as capital asset pricing model beta's are not high enough to explain the differentials in returns. Similarly, mean reversion in asset prices is often attributed to alleged time-varying risk premia; the amount of risk investors are willing to bear is said to vary over time in a manner that can explain the pattern of returns. Such explanations are often thought to have a decisive debating advantage: untestability. Since risk premia are unobservable directly, how can the explanation ever be disproven? This type of thinking can

[11]Hodrick and Srivastava (1984) report less favorable risk-return tradeoffs using Bilson's (1981) data.

lead to a false sense of security, because clever researchers often think of ways of testing such untestable propositions. An analogy is concept of utility maximization, often considered an untestable tautology. However, as discussed in the previous column (Tversky and Thaler, 1990), subjects can be induced to make conflicting choices when faced with two different versions of the same problem, and of course it is impossible for both answers to be consistent with utility maximization.

As we have seen in this column, researchers in foreign exchange markets have been inventive in devising methods of testing whether risk can explain the anomalies. Indeed, the conclusion we draw from the tests completed so far is that there is no positive evidence that the forward discount's bias is due to risk (as opposed to expectational errors). Risk premia which are derived from economists' asset pricing models show no sign of being systematically related to the predictable excess returns derived from econometricians' regressions.

In addition, there is positive evidence which suggests the reverse: that the bias is attributable to expectational errors and not to risk. Attempts to separate the forward discount into expected depreciation and a risk premium using survey data on exchange rate expectations suggest that the bias is entirely due to expectational errors and that none is due to time-varying risk. While such a decomposition cannot itself shed light on whether the expectational errors are generated by learning, peso problems, or by market inefficiency, neither learning nor peso problems seem to offer complete explanations of the facts. Taken as a whole, the evidence suggests that explanations which allow for the possibility of market inefficiency should be seriously investigated.

What are the policy implications of the apparent market inefficiency in foreign exchange markets? Because the evidence for inefficiency is ambiguous, and because there exists no good general equilibrium model of exchange rates, we can say little about whether exchange rate fluctuations are costly enough to merit government intervention. Although the kind of inefficiency discussed above can lead to very large distortions in the level of the exchange rate, interventions such as transactions taxes or an exchange rate peg also involve costs to welfare. Future research may help to determine how consumers and producers are affected by the use of such blunt policy instruments.

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