The Determinants of Currency Market Forecasts: An Empirical Study

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Testing surveys of exchange rate expectations for rationality and market efficiency has become very popular in the literature. Dozens of such studies have been published, the majority of which have concluded that short-term currency market activity appears to be inconsistent with the standard neoclassical characterization (Takagi, 1991). As a result of this widespread rejection of rationality and efficient markets, many economists have (on the grounds that "irrational" behavior is non-economic and therefore inexplicable) shifted their attention to the long run (Pentecost, 1993: 179 and Taylor, 1995a and 1995b).

It is the premise of this paper that such a conclusion is neither warranted nor reasonable. Not only is there no justification for believing that irrational behavior cannot be explained (Berkson, 1989), but irrationality here is being defined in a very narrow manner. Furthermore, associating "economics" only with those activities whose character is explicable given our current set of tools is hardly an approach conducive to extending the frontier of knowledge in the discipline. It is difficult to imagine foreign exchange trading, regardless of the time horizon, being excluded from any credible definition of the economy.

This paper, rather than using foreign exchange forecast surveys as an argument for ignoring the short run, treats them as a means of understanding it. To that end, an empirical test (based on the Post Keynesian approach) of the world's largest currency market–the Deutsche Mark/U.S.

Dollar– is conducted in which the survey results serve as the dependent variable. It will be shown that, far from being incomprehensible manifestations of the actions of obtuse individuals, actual and expected short-term foreign currency price movements are in fact a function of agents' reasoned efforts to earn profits in the international portfolio capital market. This has the further effect of reinforcing the Post Keynesian argument that the impact of international capital flows on exchange rates is more than simply white noise (Harvey, 1996). A successful theory of currency price movements **must** consider the effect of global money markets and the manner in which they will shape market participants' actions.

The paper will proceed as follows. In the next section, various theoretical issues are addressed and a brief comparison of the orthodox and post Keynesian approaches to exchange rates is offered. Following that, a theoretical model is constructed, which consequently forms the basis of the empirical test. The results are then presented and discussed, and a short conclusion follows.

Exchange Rates and Surveys: Background and Theoretical Issues

Neoclassical Economics

Generally speaking, mainstream economists have been reluctant to use survey data, a preference based on the assumption that what agents *report* as the justification for their actions is not as reliable a basis for understanding their behavior as the rational-utility-maximizer characterization that lies at the core of the neoclassical approach. However, in the exchange rate literature this rule of thumb has been disregarded. To some extent, this has been an act of resignation as standard approaches (especially large-scale macro models) have been widely

heralded as empirical failures (Meese and Rogoff, 1983 was a particularly important article in this regard).[1] In an attempt to discover the source of these disappointments, economists (starting around the early to mid 1980's) shifted their focus to testing the underlying microeconomic assumptions of the foreign currency market (in particular market efficiency and rational expectations).[2] As this required proxying market expectations, the use of surveys of agents' forecasts was deemed acceptable.

Unfortunately, this approach was no more successful than the first. As suggested above, study after study has reached the conclusion that rational expectations and market efficiency must be rejected for foreign exchange markets. Thus, the short run has been all but abandoned as worthy of *economic* study.

One of the most interesting aspects of this literature is the fact that a group of scholars who are generally suspicious of survey data have been open to using them in an effort that ultimately casts doubt on one of their core concepts. They could hardly be blamed for demanding hard evidence that the surveys are reliable, and yet this has not been the case. The data have largely been accepted at face value, and even the usual apology for using surveys is becoming less common in published articles. Through all this there has been no attempt in the mainstream literature to establish the credibility of the forecasts.

The rationale for this apparent neglect is theoretical. From the neoclassical perspective, expectations, per se, do not affect currency prices. Rather, they are simply the mechanism by

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[1]Though natural curiosity on the introduction of several new sets of survey data in the 1980's must also have been a factor.

[2]Another impetus for this line of inquiry was the increasing evidence that technical analysis might, despite theoretical objections, be consistently profitable.

which the *fundamentals*, those variables guaranteeing the efficient operation of the market, set exchange rates (Harvey, 2000 and 1996b). Because the profession is convinced that these fundamentals are the ultimate determinants of exchange rates, the importance of the discovery that short-term market behavior is inconsistent with market efficiency and rational expectations has been discounted. Though willing to concede that the information processing aspect of markets may be inefficient over hours, days, weeks, and perhaps even months, there is nevertheless faith that this is simply white noise superimposed on an efficient long-term process.

Returning to the issue of testing the reliability of the surveys, if the role of expectations amounts to stochastic variation (as they believe the rejection of rational expectations and market efficiency suggests) then how would one go about doing so (and why bother)? To what could the proxies be compared to gauge their accuracy? If they derive from a random process then the answer is that there is nothing that could be used. Hence neoclassicism's lack of effort in this area.

Post Keynesian Economics

But theirs is not the only possible conclusion. Post Keynesian economics suggests a more active role for expectations. Recall that from the neoclassical perspective, because fundamentals essentially determine rates, short-term expectations are treated as independent of the objective variable (i.e., of currency prices). They may predict with more or less accuracy, but forecasts have no substantive effect. If expectations are correct on average, then agents are rational; if not, they are irrational. *But in either case, the underlying determinants of foreign exchange rates (i.e., the fundamentals) remain unchanged.*

But in the Post Keynesian view, based on Keynes' analysis of asset markets, expectations

are causal (for a more extensive discussion of the issues raised in the next several paragraphs see Harvey, 1998-99). Geoff Hodgson summarizes Keynes' approach:

> Actions flow from judgements about the future (which often lack a firm, objective empirical foundation) as well as from observation of "the convention" that is formed by the action of others (Hodgson, 1985: 13).

Because "actions flow from judgments," the significance of expectations is as the driving force of economic activity. Entrepreneurs invest and bring products to market because they *expect* profit; workers offer labor services for sale because they *expect* to be able to accumulate wealth; portfolio investors buy and sell assets because they *expect* to earn capital gain; and so on.

Since action is based on expectations, expectations affect the objective variable. This is especially important in asset markets, which is what the modern market for foreign currency has become (Harvey, 1998-99 and 1999). Thus for currency prices, *expectations are not simply a passive forecast of future rates, but the active force in setting current ones*. In other words, the significance of today's prediction of the dollar-mark rate one week hence is not so much the accuracy of that prediction, but its impact on existing portfolios and the resulting change in the dollar-mark rate **today**.

What all this means is that not only is there a reason to be interested in testing the reliability of the surveys, but a method is available: forecasts of the future can be compared to the current rates they affect. Such studies have already been undertaken in Harvey and Quinn (1997) and Harvey (1998-99), with the result that a significant correlation was found between expectations and current (slightly lagged) actual rates. The findings of these papers argue that the survey data are reliable, which further suggests that they may contain important information useful for understanding short-term currency market activity.

The latter is the premise of this paper. If it is the case that foreign exchange forecasts are a

major influence on short-term currency prices, then the next logical step to understanding those prices is the dissection of the forecasts. By doing so we should gain insight into which factors are the foci of market participants, information valuable for both theory and policy.

Theoretical Model

If expectations play such a strong role in determining short-term foreign currency prices, then by what are those expectations determined? Unfortunately, theory offers very little guidance. Short of rational expectations, which is at any rate an explanation only of the outcome and not the process, economics has little insightful to add. Psychological approaches are much more enlightening, but difficult to operationalize (Tversky and Kahneman, 1974). One thing that is clear about currency markets is that they are dominated by short-term portfolio capital flows (Harvey, 1999: 202-203). As such, one would expect that the variables capturing the attention of market participants in the formation of the forecasts would be those most important in global asset markets: rates of return, risk, and national inflation differentials. In addition, especially if the time horizon is very short, market psychological factors (including the sort suggested by Keynes in his definition of "speculation (Keynes, 1964: 158)) may come into play.

The brief discussion above suggests the following:

$$(1) \qquad S_t^{t+n} = f(R_t^{t+n}, \tilde{n}_t^{t+n}, P_t^{t+n}, \emptyset_t^{t+n}) \qquad (+, +, +, +)$$

Where S_t^{t+n} is period t's market expectation of the price of the domestic currency (in foreign currency units) in period t+n, R_t^{t+n} is period t's expectation of the excess return available on domestic versus foreign assets through t+n (including that derived from asset price movements), $\tilde{n}_t^{t+n}$ is agents' period t evaluation of the risk of holding foreign assets through period t+n, P_t^{t+n} is

the market's period t forecast of the excess of foreign inflation over domestic through t+n, and $ø_t^{t+n}$ is agents' period t anticipation of market psychological factors that would favor domestic currency over t+n (note that each variable was defined so that its effect on the dependent would be positive).

One could certainly justify a more complex representation of the expectation formation process. Even if, for example, equation (1) includes all relevant factors, it is still necessary to take into account the fact that each of the independent variables depends on a myriad of subjective considerations on the part of currency market participants, including political factors, the timing of announcements, etc. However, I have opted for a simple specification given the limited purposes of the current paper and the fact that data constraints are going to preclude a more complex representation of the underlying process.[3]

Empirical Test

Testing equation (1) provides several challenges, especially in terms of data availability. In order to make the best use of what was obtainable a number of tedious calculations were necessary. The reader is spared this detail below, but can find it in the appendix. The primary emphasis in what follows is on how the various series represent equation (1).

Easiest to specify was the dependent variable: the market forecast of the Deutsche Mark-U.S. Dollar exchange rate (measured DM/$). The survey data published by Money Market

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[3]Note that while it is entirely possible that the process modeled by equation (1) may lead to market efficiency and optimality, the Post Keynesian approach does not *assume* (as is true of fundamentals-based approaches) that this will be the case. Markets are social institutions, subject to the mores, world views, prejudices, and idiosyncrasies of the culture from which they are drawn. The welfare consequences of outcomes created by a market system are not preordained.

Services are very popular and are used here. As the participants in the survey are polled regarding both their one-week and one-month ahead forecasts of the spot rate, two separate regressions are run. These data are weekly and run from the second week of January 1987 through the second week of June 1996.[4] All other data were collected to match this time period.

As for the independent variables, R_t^{t+n} was proxied using short-term (one-month) eurocurrency interest rates. The assumption was that as the most generic and unregulated rate of return available on international assets, these should work well as a measure of the rate of return available on dollar and Deutsche Mark investments. It appears as $Spread_t^{t+n}$ in equation (2) below and is measured: the one-month eurodollar interest rate minus the one-month euromark interest rate.

The effect of variables P_t^{t+n} and $\tilde{n}_t^{t+n}$ can also be captured using eurocurrency rates, though their independent effects are lost. Since subtracting short-term interest rates from long-term ones yields the premium required to offset agents' liquidity preference, inflation expectations, and risk assessments, then subtracting that premium for euromark interest rates from that for the eurodollar should give the market's expectation of the *excess* of inflation and risk in Germany over that expected in the United States (where liquidity preference would cancel out assuming the same agents are participating in both markets; one-month rates were subtracted from twelve month ones to create the premium for each country). This variable is $Premium_t^{t+n}$ in equation (2).

The factors reflected in ϕ_t^{t+n} are those used to predict market psychology. Though this has traditionally been a rather difficult factor to model empirically, two measures are actually very easy to collect. Technical analysis is the outstanding example. That this is counted as

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[4]These data were purchased with a Texas Christian University Research and Creative Activities Grant.

"psychological" may surprise some market participants, as many practitioners argue that such methods are, in fact, means of discovering the "fundamental" future of currency prices. However, scholarly interpretations suspect that their effectiveness has much more to do with self-fulfilling prophecy. Hence, these become a way of tracking very short term market psychology (Taylor and Allen, 1992). In the paper, three distinct trading rules are used: moving average, momentum, and point and figure. Each generates a +1 for a buy dollar signal, a -1 for a sell dollar signal, and a 0 if no signal is produced. As it is the sum of these three, $Rule_t^{t+n}$ in equation (2) can vary from +3 to -3 (a more detailed discussion of this variable is found in the appendix).

In addition, psychologists have discovered a great deal regarding how people (lay and expert alike) make decisions. Most important in the current context is the fact that decision makers tend to be risk averse when winning and risk taking when losing. This attitude toward risk implies that as a currency appreciates, so the likelihood that those holding it (or, more accurately, assets denominated in that currency) will "cash in," or take profits, increases. Run_t^{t+n} in equation (2) models this by showing the number of consecutive days of DM appreciation squared. As Run_t^{t+n} rises, so the likelihood of a profit-taking sell off of the mark (and hence an appreciation of the dollar) rises.

Based on both the theory suggested in (1) and the discussion above, the following regression was tested:

$$(2) \qquad S_t^{t+n} = f(Spread_t^{t+n}, Premium_t^{t+n}, Rule_t^{t+n}, Run_t^{t+n})$$
$$\qquad\qquad\qquad\qquad\quad + \qquad + \qquad + \qquad +$$

Where S_t^{t+n} is period t's market forecast of the DM/$ rate period t+n, and all other variables are defined as above. Ideally, the timing of the observations for the independent variables would be such that they were drawn just moments before the forecasts were made. Of course, this is

impossible. What is controllable is guaranteeing that none of the determinants was drawn *after* the forecast was made. In other words, it must be the case that each of the independent variables was available to market participants at the time of, and as close as possible to, their response to Money Market Services. Generally speaking, this meant that the dependent variable is from Friday of the week in question (the day Money Market Services undertakes the survey), while each of the regressors is from Thursday. The only exception to this rule involves the variables created with eurocurrency interest rate data. As these are drawn from a German market (Frankfurt, 2:00pm local time), the Friday observations of these variables should have already been available to the survey participants in New York City.[5]

The regression results are shown on Table One. The overall fit was excellent for a weekly test of a financial variable, ranging from 0.187 for the week-ahead forecast to 0.152 for the one-month ahead. That the former was more successful seems reasonable given that half of the explanatory variables (Rule and Run) were of the sort that would be expected to exert the greatest influence over agents' expectations of the short term. Of the four regressors Rule was by far the most successful. It not only proved significant in both equations, but the decline in the size

Table 1. Econometric Results.

Regression	Spread	Premium	Rule	Run	adj-R^2	D-W
Week	.65 E-2 (0.93)	-.24 E-2 (0.31)	**.38 E-2** **(8.65)**	**.031 E-2** **(2.32)**	.187	1.91

[5]As with equation (1), each variable was defined so that its coefficient could be expected to have a positive sign.

Month	.27 E-2 (0.36)	-.42 E-2 (0.51)	**.33 E-2** **(7.10)**	**.044 E-2** **(3.07)**	.152	1.87

Parenthetical numbers are absolute values of t-statistics.

Boldface entries of parameter estimates indicate rejection of the null hypothesis at the 10% level or better.

n = 405

of the parameter from the week-ahead (0.0038) to the month-ahead (0.0033) regression was intuitively appealing. Just the opposite occurred with the other psychological variable, Run, however: though it also worked well and was significant in both regressions, the parameter is larger in the month-ahead estimate. This is an unexpected result.

The interest-rate based variables did not fare as well, which, though disappointing, is not surprising. Unlike Rule and Run, the real significance of Spread is how it *differs from what agents expected it to be*. We do not know this value, and are forced to use the actual spread between the rates. Hence, Spread was significant in neither regression, a fate shared by Premium.

Conclusions

These results are important for three reasons. First, they show that the expectational variables are not random or white noise. They exhibit a pattern and are explicable. That other studies (Harvey and Quinn, 1997 and Harvey, 1998-99) have demonstrated the important role of forecasts in driving actual exchange rates magnifies the importance of this result. Though research into the determinants of agents' expectations may continue to be stymied by the sort of data problems encountered here, these positive results should nevertheless provide motivation for more in depth analyses.

Second, the position that market forecasts are strongly influenced by psychological factors receives substantial support. This had been suspected, of course, and was encouraged by anecdotal evidence, but this represents the first test and quantification of these relationships.[6]

[6]For example, in the week-ahead forecast equation, suppose that the three technical rules shifted from each generating no signal to each being bullish on the dollar. This would suggest a

Though other, more traditional, factors are bound to play a role in ways that the current study was unable to capture, this confirmation that currency rates are moved at least in part by "irrational" forces is illuminating.

Last, the results in general tended to lend support to the Post Keynesian view of exchange rate determination. Scholars taking that approach have argued that currency prices are driven primarily by portfolio capital market concerns and that the latter are marked more by Keynes' speculation than his enterprise (which then leads to a variety of practical and policy issues outside the scope of this paper). Under Keynes' speculation, agents' focus is upon forecasting the psychology of the market rather than the long-term profitability of the asset issuers. Though at this stage it would be premature to say that **no** form of enterprise is evident in the FX market, the results herein are intriguing and suggest that economists' shift toward the long run may be premature and unnecessary.

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change in the dependent variable of 0.0114, or a rise in the week-ahead forecast value of the dollar by just over one pfennig. And it can be deduced that the difference between two consecutive days of dollar appreciation and five would be 0.651 pfennigs.

APPENDIX
Data and variable descriptions

The data are weekly from the second week of January 1987 through the second week of June 1996. The total number of observations (once weeks with missing data, due to holidays, were removed) was 405.

Dependent variable:

The dependent variable is market expectations. Money Market Services (MMS) survey data is used to proxy this. They are collected on Friday mornings, roughly some time before noon, New York City. The professionals contacted are queried regarding their best forecast of various exchange rates one week and one month hence. The figure reported by MMS is the median. The focus of the current paper is the Deutsche Mark -U.S. Dollar exchange rate (measured DM/$).

The particular form of the variable employed in the empirical test was the *change* in the forecast from one week the next, such that the dependent variable for week t would actually be week t's prediction minus week t-1's. In the event that an observation for either week t or week t-1 was not available (due to holidays) it was omitted (rather than have some variables representing one week's difference and others two or more weeks). The dependent variable is always from Friday.

RULE:

The independent variable used to proxy the influence of technical analysis was actually constructed from three distinct trading rules. This was done in order to take some account of the fact that market participants are bound to employ a variety of methods. Given this, however, the choice of not only which rules to choose but how to specify each is problematic (a single rule can be programmed in many ways given, for example, different lag structures) . In order to avoid the temptation to search for the ones that would result in the best fit for the regression I chose to simply adopt those used by Stephan Schulmeister's excellent research (1987 and 1988): moving average, momentum, and point and figure (Harvey, 1993 also uses these and finds them to be a significant determinant of the $/DM rate in 1989).

A typical moving average compares a short-term average currency price with a long term one. Whenever the former is greater than the latter this is a signal to buy that currency. As per Schulmeister, the current study specifies the short term as three days and the long term as ten. A momentum rule is a much simpler version of the above, with the most recent known spot rate compared to some past date's. When the former exceeds the latter, the signal is to buy the currency in question. Again following Schulmeister, the past date used is eight days prior to today. Finally, the point-and-figure rule involves examining a plot of the exchange rate's time series. Whenever the current rate rises above (falls below) the most recent peak (trough) this is a signal to buy (sell) the currency.

Each individual rule gave a +1 for a "buy dollars" signal, a -1 for "sell dollars," and a 0 when no signal was produced. Since RULE is the sum of all three, it could vary from +3 to

-3. As the dependent variable is measured DM/$ this makes the expected sign of the parameter of RULE positive (note that all the independent variables were defined so that their coefficients could be expected to have a positive sign).

RULE, like the dependent variable, is differenced (RULE minus the previous week's RULE). In addition, to ensure that the information from the technical analysis would have been available to the agents making the forecasts, the RULE observations are Thursday.

These values were constructed by the author using spot currency data from the Federal Reserve Bank of Chicago web site (www.frbchi.org).

RUN:

RUN is the number of consecutive days of Deutsche Mark appreciation squared (with the negative sign retained for depreciation). For example, if on Monday the value of the Mark rose (after a decline on Friday), this variable would be 0. If the appreciation continued through Tuesday, RULE=1. By Wednesday, such a trend would yield RULE=4, which would rise to 9 by Thursday, and so on. As with the other independent variables, the observations are drawn from Thursdays and are in fact the change since the previous week.

The variable is defined as the "run" in the Mark so that it can be expected to be positively correlated with the dependent variable. It is squared because of the evidence from Harvey (1993) that the discomfort at not realizing profits (by selling the related assets) that agents experience as the value of their portfolios rises tends to increase exponentially rather than

arithmetically.

These values were constructed by the author using spot currency data from the Federal Reserve Bank of Chicago web site (www.frbchi.org).

SPREAD:

SPREAD proxies international rates of return using the eurodollar and euromark interest rates. Specifically, the one-month euromark interest rate is subtracted from the one-month eurodollar interest rate. Again, the variable is differenced and taken from Friday observations (though as they Frankfurt, 1400 hours these would be known by market opening in New York City) . It is defined so that the expected sign of its parameter will be positive.

The interest rate data used to make these calculations were kindly provided by the Department of Statistics at the University of Bonn.

PREMIUM:

PREMIUM captures the effect of expectations of both risk and inflation. It is measured by subtracting the premium on twelve-month versus one-month eurodollar rates from the premium on twelve-month versus one-month euromark rates. The variable is differenced and taken from Friday observations (again because these are from Frankfurt). The

expected sign of its parameter is positive.

The interest rate data used to make these calculations were kindly provided by the Department of Statistics at the University of Bonn.

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