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Chartists, Fundamentalists, and Trading in the Foreign Exchange Market

Jeffrey A. Frankel
Department of Economics
University of California
Berkeley, CA 94720

Kenneth A. Froot

Graduate School of Business
Harvard University, Soldiers Field
Boston, MA 02163

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By Jeffrey A. Frankel and Kenneth A. Froot*

The overshooting theory of exchange rates seems ideally designed to explain some important aspects of the movement of the dollar in recent years. Over the period 1981-1984, for example, when real interest rates in the United States rose above those among trading partners (presumably due to shifts in the monetary/fiscal policy mix), the dollar appreciated strongly. It was the higher rates of return that made U.S. assets more attractive to international investors and caused the dollar to appreciate. The overshooting theory would say that, as of 1984 for example, the value of the dollar was so far above its long-run equilibrium that expectations of future depreciation were sufficient to offset the higher nominal interest rate in the minds of international investors. (Figure 1 shows the correlation of the real interest differential with the real value of the dollar, since exchange rates began to float in 1973.)

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* Department of Economics, University of California, Berkeley, CA 94720, and Graduate School of Business, Harvard

University, Boston, MA 02163. The authors would like to thank MMS International for data and Lu Cordova and Joseph Mullally for valuable research assistance.

I. Bubble Episodes

At times, however, the path of the dollar has departed from what would be expected on the basis of macroeconomic fundamentals. The most dramatic episode is the period from June 1984 to February 1985. The dollar appreciated another 20 per cent over this interval, even though the real interest differential had already begun to fall. The other observable factors that are suggested in standard macroeconomic models -- money growth rates, real growth rates, the trade deficit -- at this time were also moving in the wrong direction to explain the dollar rise.

It is now widely accepted that standard observable macroeconomic variables are not capable of explaining, much less predicting *ex ante*, the majority of short-term changes in the exchange rate. But economists divide into two camps on what this means. One view is that the unexplained short-term changes must be rational revisions in the market's perception of the equilibrium exchange rate due to shifts in "tastes and technologies," even if the shifts are not observable to macroeconomists in the form of standard measurable fundamentals. A major difficulty with this interpretation is that it is difficult to believe that there could have been an increase in the world demand for U.S. goods (or in U.S. productivity) sufficient to increase the equilibrium real exchange rate by more than 20 per cent over a 9-month period, and that such a shift would then be reversed over the subsequent 9 months.

Figure 1

Notes: The CPI-adjusted dollar is a weighted-average index of the exchange value of the dollar against the currenices of the foreign G-10 countries plus Switzerland, where nominal exchange rates are multiplied by relative levels of CPI's. Weights are proportional to each foreign country's share in world exports plus imports from 1978 through 1983. The long-term real interest differential is the U.S. rate minus the weighted average of foreign-country weights.

Source: Peter Hooper and Catherine Mann, Federal Reserve

Board.

This brings us to the second view, which is that the appreciation may have been an example of a speculative bubble: that it was not determined by fundamentals, but rather was the outcome of self-confirming market expectations. The dollar in 1985 "overshot the overshooting equilibrium." Some have suggested that the appreciation of 1988-89, on a smaller scale, may also have been of this nature.

There exist elegant theories of "rational speculative bubbles," in which all participants know the correct model. Some observers have suggested that 1984-85 may best be described as a bubble that was not characterized by rational expectations.[1] We have suggested that such episodes may best be described by models of bubbles in which market participants do not agree on the model for forecasting the exchange rate.[2]

While the conventional approach in the literature, theoretical as well as empirical, is to assume that there is such a thing as "the" market expectation of the future exchange rate, there is evidence that investors have heterogeneous expectations. For one thing, surveys of the forecasts of participants in the foreign exchange market show wide dispersion at any point in time. One conducted by the Financial Report (affiliated with the Economist) reports a high-low range of six-month forecasts that averages 15.2 per cent. Data in a survey conducted by MMS International show a dispersion of opinion (as measured by the standard deviation across respondents) at the one-month horizon that averaged 2.2 per cent for the yen/dollar rate. The dispersion was slightly higher for the mark, pound and Swiss franc rates.

II. Trading in the Foreign Exchange Market

The tremendous volume of foreign exchange trading is another piece of evidence that reinforces the idea of heterogeneous expectations, since it takes differences among market participants to explain why they trade. The Federal Reserve Bank of New York has released its three-yearly count of transactions in the U.S. foreign exchange market. It showed that in April 1989, foreign exchange trading (adjusted for double-counting) totaled $128.9 billion a day, an increase of 120 per cent from March 1986. Simultaneous counts in London and Tokyo reported $187 billion and $115 billion a day, respectively. Thus the worldwide total is over $430 billion of foreign exchange trading a day.

Interestingly, the banks in the New York Federal Reserve Bank census reported that only 4.9 per cent of their trading was with a nonfinancial firm, and the nonbanks only 4.4 per cent; in other words, 95 per cent of the trading takes place among the banks and other financial firms, rather than with customers such as importers and exporters. Clearly, trading among themselves is a major economic activity for banks.

What is the importance of trading volume (beyond motivating the importance of heterogeneous expectations)?

There are three possible hypotheses, with regard to implications for movements in the market price. (1) The higher the liquidity or "depth" of the markets, the more efficiently is news regarding economic fundamentals processed and the smaller is "unnecessary volatility" in the exchange rate. (2) The foreign exchange market is already perfectly efficient, so that trading volume is irrelevant to price movements and therefore uninteresting. (3) Much trading is based on "noise" rather than "news," and leads to excessive volatility.

Choosing convincingly among these three hypotheses may be too large a task to accomplish here. But there is evidence that trading volume, exchange rate volatility, and the dispersion of expectations among forecasters are all positively related. We have developed a weekly data set for four currencies (British pound, German mark, Japanese yen, and Swiss franc), covering the period October 1984 to February 1988. Trading volume is measured by the weekly number of futures contracts (nearest-term) traded on the IMM of the Chicago Mercantile Exchange, volatility is measured by the squared percentage 15-minute-changes in the futures price, averaged over the week, and dispersion is measured by the percentage standard deviation of forecasts across respondents in the survey conducted weekly by MMS International.

Granger-causality tests on pre-whitened data, reported in

Table 1, show that the degree of dispersion has strong effects on the market. Dispersion Granger-causes volume at the 90 per cent level in three currencies out of four, whether dispersion is measured in one-week or one-month forecasts. Dispersion also Granger-causes volatility, in three out of four currencies at the one-week horizon, and four out of four at the one-month horizon. We also find that the contemporaneous correlation between volume and volatility is high: .515 for the pound, .316 for the mark, .412

for the Swiss franc, and .417 for the yen.

One interpretation of these results is that the existence of conflicting forecasts leads to noise-trading -- the causation runs from dispersion to the volume of trading, and then from trading to volatility -- though there probably exist other interpretations as well. The Granger test does not show statistically-significant causation running directly from volume to volatility. But one would expect any such causality to be purely contemporaneous, and it is important to keep in mind that the Granger test cannot detect this type of causality.

It should be noted that the tests in Table 1 also show that volatility Granger-causes dispersion: Volatility Granger-causes one-week dispersion for all four currencies, and one-month dispersion for three out of four. We think that this apparent effect may be partly spurious: the MMS survey catches different respondents at different times of the day, so their forecasts of the expected future level of the exchange rate will differ more if the level of the spot rate on that day moves around more. On the other hand, it is easy to see how higher lagged volatility could cause higher dispersion of expectations because forecasters use different models to interpret the data.

Other results in Table 1 are that volume Granger-causes both one-week and one-month dispersion in only one of four currencies. Lastly, volume and volatility do not appear to be Granger-related in either direction.

Granger-causality tests on pre-whitened data show that the degree of dispersion has strong effects on the market. Dispersion Granger-causes volume at the 90 per cent level in three currencies out of four. Dispersion also Granger-causes volatility. We also find that the contemporaneous correlation

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III. The Rising Importance of Chartists

We now turn to the question of how the existence of different forecasting techniques might lead to "excess volatility." It has long been remarked that if there exist traders who tend to forecast by extrapolating recent trends, i.e., who have "bandwagon expectations," then their actions can exacerbate swings in the exchange rate. Many so-called "chartist" forecasters, or technical analysts, are thought to use rules that are extrapolative, such as, "Buy when the one-week moving average crosses above the twelve-week moving average."

How do speculators form expectations in practice? Frankel and Froot (1988) offered evidence from the survey data that, at short horizons, respondents tend to forecast by extrapolating recent trends, while at long horizons they tend to forecast a return to a long-run equilibrium such as PPP. Table 2 reports an update of these estimates. The coefficients reported are to be interpreted as answers to the question, "for every 1 per cent that the dollar appreciates in a given week, what percentage change does the median respondent forecast for the dollar thereafter?" The answer at the 1-week horizon is another .13 per cent in the same direction. At the 4-week horizon, the extrapolation is smaller. Respondents expect that, by the time 3 months have passed, the dollar will be lower than at the day when they are formulating their forecasts, and lower still at 6 months. One year out, they expect the dollar to be .33 percent lower, for every one percent that the dollar has appreciated this week.

This leads to the question: which kind of forecasters dominate the market, those who think short-term, and appear to have bandwagon expectations, or those who think long-term and have regressive expectations? Since Milton Friedman (1953), the standard argument against the importance of destabilizing speculators is that they will on average lose money, and be driven out of the market in the long run. A number of special counter-examples to the Friedman argument have been constructed over the years, most involving heterogeneous actors (e.g., "suckers" who lose money and "sharpies" who win). The simplest counter-example would be based on the theory of rational speculative bubbles, where each market participant loses money if he doesn't go along with the herd.

The problem with this theory, which identifies speculative bubbles with the unstable paths in a rational-expectations saddle-path problem, is that it has nothing to say about what causes a bubble to start. What, for example, generated a speculative bubble in the period leading up to February 1985, if that is what the dollar surge evident in Figure 1 was?

The model of speculative bubbles developed in Frankel and Froot (1988) says that over the period 1981-85, the market shifted weight away from the fundamentalists, and toward the technical analysts or "chartists." This shift was a natural Bayesian response to the inferior forecasting record of the former group, as their forecasts of dollar depreciation continued to be proven wrong month after month. The change in the weighted-average forecast of future dollar depreciation in turn changed the demand for dollars, and therefore its price in the foreign exchange market.

Is there any sort of evidence for such a theory? Euromoney magazine runs a yearly August review of between 10 and 27 foreign exchange forecasting services. Summary statistics are reported in Table 3. The trend is very clear. In 1978, 18 forecasting firms described themselves as relying exclusively on economic fundamentals, and only 2 on technical analysis. By 1985, the positions had been reversed: only 1 firm reported relying exclusively on fundamentals, and 12 on technical analysis.[3]

In short, it may indeed be the case that shifts over time in the weight that is given to different forecasting techniques are a source of changes in the demand for dollars, and that large exchange rate movements may take place with little basis in macroeconomic fundamentals.

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Table 2: Do Forecasters Extrapolate?

OLS Regressions of Expected Future Rate of Depreciation Against Most Recent Actual Depreciation

Survey data source and sample period	Term of forecast	Estimate of extrapolative parameter	t-ratio (with GMM s.e.)
MMS International	1 week	.13	4.32[a]
Oct.1984- Jan. 1988	4 week	.08	1.60
Economist June 1981-	3 month	-.08	-2.98[a]
Aug.1988	6 month	-.17	-4.98[a]
	12 month	-.33	-5.59[a]

[a] Significant at 99 percent confidence level.

Table 3: Techniques Used by Forecasting Services

year	total	chartist	fund.	both
1978	23	3	19	0
1981	13	1	11	0
1983	11	8	1	1
1984	13	9	0	2
1985	24	15	5	3
1988	31	18	7	6

Source: Euromoney, August issues.

Notes: total = number of services surveyed, chartist = number who reported using technical analysis, fund. = number who reported using fundamentals models, and both = number reporting a combination of the two. When a forecasting firm offers more than one service, each is counted separately.

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Survey Data Source	MMS International		*Economist*		
Sample period	Oct.1984-Jan.1988		June 1981-Aug.1988		
Term of forecast	1-wk.	4-wk.	3-mo.	6-mo.	12-mo.
Estimate of extrapolative parameter	.13	.08	-.08	-.17	-.33
t-ratio (with GMM s.e.)	4.32[a]	1.60	-2.98[a]	-4.98[a]	-5.59[a]

a Significant at 99 per cent confidence level.

Table 3: Techniques Used by Forecasting Services

year	# of services surveyed	# using technical models	# using fundamentals	# using both models
1978	23	3	19	0
1981	13	1	11	0
1983	11	8	1	1
1984	13	9	0	2
1985	24	15	5	3
1988	31	18	7	6

Source: *Euromoney*, August issues.

When a forecasting firm offers more than one service, each is counted separately. Some services did not indicate the nature of their technique.

[Endnotes]

aul Krugman (1985) was one of the first to suggest that the market did not a
alize the extent to which the appreciation of the dollar was not sustaina
es Engel and James Hamilton (1990) find that long-term swings are a ge
cteristic of exchange rates, and that they are not adequately reflected in
rd market. Such findings of predictable excess returns are standardly interp
sk premiums. But evidence from survey data on expectations of market partici
sts that the prediction errors of the forward market are <u>not</u> due to risk pre
t and Frankel, 1989).

rankel and Froot (1990a).

number of firms combine the two approaches, or else offer a separate servi
kind; in this case, usually technical analysis is used for short-term foreca
undamentals for long-term forecasting. This pattern matches up well wit
ssion results from surveys of market participants regarding exchange
tations, reported above. The pattern is also confirmed in Taylor and
), who report that at short horizons approximately 90 percent of respondents
chartist input in forming their expectations, and 60 percent judge charts to
tant as fundamentals, while at the horizon of one-year and longer, near
nt rely purely on fundamentals, and 85 percent judge fundamentals to be
tant than charts.