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Volatility in the Foreign Exchange and Stock Markets: Is It Excessive?

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This paper examines recent theoretical and empirical analyses that may help us understand and eventually model the observed movements of foreign exchange rates and stock prices. Whether these prices are rational, efficient, and hence not excessively volatile is, of course, a joint hypothesis. The question in the title can never be answered in the abstract. We must always compare actual volatility to the volatility implied by a benchmark model.

I. What Are Market Fundamentals?

The debate therefore must be about the nature of market fundamentals, which are the economic forces that models with rational behavior predict are the determinants of asset prices. For the stock market, simple rational models imply that real stock prices are the discounted expected values of future real dividends. Hence, market fundamentals are the future dividends that an investor will receive and the current and future discount rates. Notice that this definition says nothing about the stationarity or ergodicity of dividends or dividend growth, the presence or absence of taxes, how market participants learn, or why required rates of return move over time.

Unfortunately, conducting inference about the volatility of asset prices does require explicit assumptions about these issues, especially about the relation of the past to what agents think the future will be like. Robert Flood and I (1990) discuss the importance of correctly identifying market fundamentals in the context of testing for bubbles in asset prices. We stressed that tests for bubbles are interesting specification tests, but must be interpreted with care. This may be telling us only that people expect the future to be different from the past.

Determination of market fundamentals for exchange rates requires general equilibrium considerations since exchange rates play many roles in an economy. Surely, the demand for and supply of money are important for we know what happens to money supplies and exchange rates during hyperinflations. Apparently, as Richard Meese and Andrew Rose discuss in this session, such influences are not center stage currently for movements in the values of major currencies.

Changes in exchange rates also change the relative prices of goods, which affects trade balances and the accumulation of net foreign assets. One market fundamental of exchange rates that is particularly poorly measured is changes of wealth across countries. Meese and Rose use cumulated trade balances to measure net foreign assets, but capital gains are not part of the balance of payments.

Robert Eisner and Paul Piper (1990) examine how U.S. net foreign asset data must be changed if asset values are market-to-market. The Bureau of Economic Analysis reports dollar values of foreign direct investment by multiplying historical book values of U.S. investment overseas by the current exchange rate. No adjustments are made for changes in the local currency values of the investments. Similarly, no changes are made to the dollar values of foreign direct investment in the United States. The Bureau of Economic Analysis (BEA) reports a 1988 U.S. net foreign liability of $532.5 billion, but Eisner and Piper's alternative is $117.1 billion.

Changes in wealth of this magnitude must have important influences on models of exchange rate determination. If Eisner and

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Piper are correct, it is much less surprising that the dollar strengthened in 1989. This is because additional depreciation of the dollar to improve the competitive position of U.S. industries to in turn prevent additional accumulation of debt was not necessary. Such adjustments strengthen the case for rationality of foreign exchange markets and for the modeling of capital flows as described in my 1989b paper.

II. Are Agents Risk Neutral?

Early papers on stock price and exchange rate volatility assumed that economic agents are risk neutral, which implies that expected returns on assets are equal and constant in real terms. Although this greatly simplifies the problem of determining market fundamentals, it does not imply that nominal stock prices or exchange rates follow a random walk, with or without drift. Without risk neutrality, there is no presumption that asset returns are expected to be the same either across assets or over time. Time-varying risk premiums complicate studies of excess asset price volatility because things that change risk premiums on assets are legitimate market fundamentals.

My 1987 book surveys some statistical evidence about the nature of risk premiums in the foreign exchange market. An important message is that we do not have a model of the risk premium that is not rejected by the data. Hence, we have three possible alternative interpretations of the data, each of which may be influencing the statistical analysis.

One possibility is that the market is inefficient. In this case the expected return to speculation is more than sufficient to compensate speculators for bearing risk. Although volume in the foreign exchange market is estimated to be over $130 billion per day, which is prima facia evidence that people are taking risks, turnover per se is unimportant. Open positions must be taken if risk is to be borne, and we have little data on this issue.

A second interpretation is that there is learning in the markets. Karen Lewis (1988; 1989a, b) explores various aspects of learning in the foreign exchange market. The possibility that learning is important received empirical support from Jeffrey Frankel and Kenneth Froot (1987), and the interested reader is referred to their paper in this session for additional insight.

A third possibility is that the data do not satisfy the statistical assumptions that we must employ in order to conduct inference. Nothing in economic theory guarantees that government policies or the choices of economic agents produce time-series that satisfy the assumptions of stationarity and ergodicity.

III. Recent Theoretical Advances

Interesting new theoretical models examine stochastic variation in the conditional variances of traditional market fundamentals as sources of variability in expected returns and asset prices. Andrew Abel (1988) parameterizes an asset pricing model of Robert Lucas (1978) to allow serially correlated dividends and conditional variances of dividends. Abel finds "that the magnitudes of the effect on stock prices of increased dividend volatility is an increasing function of the persistence of the increase in volatility" (p. 385). He assumes that the representative agent maximizes a utility function that is separable across time and has constant relative risk aversion with coefficient α. Many of his results, such as the response of stock prices to a change in dividend volatility, hinge on whether α is greater or less than one.

Alberto Giovannini (1989) extends Abel's model to a monetary economy as in the analysis of Lars Svensson (1985). Otherwise, the specification is similar to Abel's, yet the results are surprisingly different. Giovannini notes that, in this class of models, α is also the reciprocal of the elasticity of intertemporal substitution. Abel finds that increases in dividend variability decrease stock prices if $\alpha < 1$ and increase stock prices if $\alpha > 1$. Giovannini finds just the opposite. He reconciles the difference in findings by noting that large α's imply low intertemporal substitution.

An increase in uncertainty about future consumption increases precautionary saving

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when substitutability of consumption across periods is low. In such a situation, if agents could decrease current consumption, they would; but in general equilibrium, current consumption is given by the nonstorable endowment. Hence, for savings to rise in Abel's model, stock prices rise. In Giovannini's model, there can also be a portfolio shift out of stocks and into money. Stocks are less liquid than money and cannot be used to finance consumption in the next period. Hence, when increased uncertainty about the future causes a desired increase in saving to finance consumption in the next period, stock prices fall as agents shift out of stocks and into money.

My 1989a paper extends these results to a two-country model in which the monetary and endowment processes are conditionally heteroscedastic. Hence, exchange rates, interest rates, stock prices and all risk premiums depend on the conditional variances of the exogenous processes. I impose identical tastes across countries, which allows for an analytical solution using the perfectly pooled equilibrium first employed by Lucas (1982). Unfortunately, this solution also imposes purchasing power parity, which we know is grossly violated in the data.

IV. Recent Empirical Analyses of Stock Price Volatility

Recent empirical analyses that address the determinants of stock price variability now recognize that expected returns vary over time and that it is more likely to be true that the price-dividend ratio is a stationary variable than that the level of price or detrended price is stationary.

For example, John Campbell and Robert Shiller (1988a, b) develop a log-linearized vector-autoregressive (VAR) methodology to test asset pricing models. Observable candidate determinants of expected returns on stocks enter the VAR with the logarithm of the price-dividend ratio and dividend growth. Campbell-Shiller test the asset pricing models and reject them all, but they also calculate the variance of the price-dividend ratio implied by various models. Typically, the standard deviations of the implied price-dividend ratios are one-half to two-thirds that of the actual series. A major finding is that variation in the expected return on stocks relative to short-term interest rates will be necessary to reconcile models with the data.

Campbell-Shiller (1989) also conduct a Monte Carlo analysis of their methods. While many of the simulated test statistics are well-behaved, several that rely on nonlinear transformations are not. The results are also sensitive to the presence of near unit roots in the vector autoregression.

Other empirical analysis that is providing interesting and controversial results is the literature on the long-horizon predictability of stock returns. Eugene Fama and Kenneth French (1988a, b; 1989), James Poterba and Lawrence Summers (1988), Andrew Lo and A. Craig MacKinlay (1988) and others document return predictability at horizons from one week to several years.

Fama and French use a regression methodology and find that variables like dividend yields, the yield spread in the term structure of interest rates, and the junk bond default premium have predictive power for returns on portfolios of stocks and bonds.

Poterba-Summers and Lo-MacKinlay both employ a variance-ratio methodology. If returns were independently and identically distributed, the ratio of the variance of returns over k months, when divided by k, to the variance of returns over 12 months, when divided by 12, would be one. For the NYSE value-weighted real returns for the period 1926–85, Poterba-Summers find values at the 48-month horizon of 0.747 (0.232) and at the 96-month horizon of 0.575 (0.394) with Monte Carlo standard errors in parenthesis. For the NYSE equal-weighted real returns, the corresponding values are 0.745 (0.232) and 0.353 (.394).

Notice that none of these test statistics is more than two standard deviations from zero. Poterba-Summers argue that if one insists on applying a .05 probability of a Type I error when testing the null hypothesis that returns are serially uncorrelated, there is often a very high probability of committing a Type II error. Hence, even though most of their estimates fail to fall more than two standard

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deviations away from the value implied by the null hypothesis of constant expected returns, they reject the null hypothesis. This is because the point estimates are similar to values that are produced when as much as three-fourths of the variance in returns is due to highly serially correlated transitory components in stock prices, and because of the consistency of the evidence across a variety of data sets.

This literature is controversial as evidenced by the papers of Myung Kim et al. (1989), Matthew Richardson (1988), and James Stock and Richardson (1989). Kim et al. argue primarily that the results of autocorrelation based tests are very sensitive to inclusion of the depression and that there is no evidence of negative serial correlation in returns when it is excluded. Richardson and Stock-Richardson argue, among other things, that the small sample properties of these test statistics are poor.

My paper with Lars Hansen (1989) examines alternative ways of doing inference and measurement about long-horizon forecasting issues using only one-step ahead information. We found that long-horizon test statistics may have poor small sample properties, but the most interesting results are from one-step-ahead vector autoregressions of returns and dividend yields. The dynamics of the VAR imply long horizon R^2s of returns measured as one minus the ratio of the innovation variance of the sum of returns over k months to the total variance of the sum of returns over k months. For the period 1948–87, the one-step-ahead R^2 is between 3 and 11 percent depending on the order of the VAR, but the R^2s always rise to over 40 percent for the sum over 48 months ahead, regardless of the order of the VAR. Monte Carlo simulations indicate that such findings are very unlikely to be produced by chance.

These results are related to findings of Campbell (1989) who develops measures of the persistence of expected returns from similar VAR models. Campbell asks how much must the current stock price fall when the expected return rises in order that the dynamics of expected returns are consistent with the data. With monthly data for 1952 to 1988, he finds a point estimate of a 5.8 percent fall for a 1 percent innovation in the current expected return.

V. Conclusions

One message of this paper is that movements in conditional variances of market fundamentals are legitimate market fundamentals that imply both movements in expected returns and movement in conditional variances of asset prices. Richard Baillie and Tim Bollerslev (1989) document movements in conditional variances for foreign exchange rates and French et al. (1987) provide analysis for the stock market. Integrating these analyses into economic models is a challenging area for future research.

I think full explanations of observed volatilities in these markets may require models with differential information across agents and learning about government policies and the nature of technology. I say this because many economists seem to think there is no rational explanation for the October 1987 worldwide stock market crash, and my own explanation relies on these features as in the following scenario.

Substantial bad news about the U.S. trade balance was accumulating. This increased the likelihood of a trade war that would be bad for the profitability of corporations in all countries and increased speculation that foreign investors would dump dollar assets because the dollar would have to depreciate to correct the trade balance. The market needed answers to questions like could and would the Federal Reserve defend the dollar, would such attempts increase real interest rates and create a recession, how badly would a recession aggravate the budget deficit, and what would be the response of foreign governments to these events. Differences of opinion across market participants about the answers to these questions caused trading volume to increase by much more than the market thought could be done with existing technology. The combination of the increase in bad news and the increase in volume and volatility forced stock prices to fall, partly in response to the bad news and partly to produce higher expected returns. Fortunately, no trade was started, no major recession

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ensued, and reasonable government policies were followed around the world.

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