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MONETARY MODELS OF DOLLAR/YEN/EURO NOMINAL EXCHANGE RATES: DEAD OR UNDEAD?

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In Meese and Rogoff (1983*a*), we argued that it is surprisingly difficult to explain systematically, much less predict, movements in major-currency nominal exchange rates. Using rolling regressions to estimate a variety of (then) state-of-the-art monetary exchange rate models, we found that, at horizons of up to one year, none could out-perform the predictions of a simple random walk model.[1] Remarkably, this result obtained even when the predictions of the models were based on *ex-post*-realised values of the explanatory variables. In other words, the standard exchange rate models we estimated exhibited extremely poor out-of-sample fit.[2] At the time, these nihilistic results seemed quite radical, since there was widespread optimism about the potential of monetary models, especially sticky-price monetary models, to explain how flexible exchange rates function. After all, the main cornerstones of monetary exchange rate models were relatively non-controversial: long-run purchasing power parity (or some variant of PPP), and a presumption that there is a strong long-run connection between money growth and inflation.

Today, the Meese and Rogoff (1983*a*) results no longer seem quite so crazy. Despite longer data sets on modern floating rates, and the application of more sophisticated econometric techniques, researchers have continued to find it very frustrating to firmly demonstrate any systematic relationship between exchange rates and macroeconomic fundamentals, at least for the cross rates between the dollar, DM (euro) and yen. It is true that researchers have occasionally found particular sub-samples where certain models seem to perform noticeably better than the random walk model but, as a rule, these results wilt under sustained out-of-sample testing. Surveying the evidence in their survey for the *Handbook of International Economics*, Frankel and Rose (1995) conclude that numerous attempts to overturn the Meese and Rogoff (1983*a*) results have failed.

1. Long-Horizon Results

It is true that when one starts to look at forecast horizons over one year, the performance of structural exchange-rate models does appear to improve, at

[1] The most basic monetary models generally incorporate variables such as the money supply, output, and interest rates to explain nominal exchange rate movements; see Frankel and Rose (1995).

[2] An entirely separate question is whether the forward exchange rate can outperform the random walk model, and at what horizons. Even if it did, this does not demonstrate any empirical connection between macroeconomic fundamentals and the nominal exchange rate. In fact, the evidence is quite mixed (see Obstfeld and Rogoff (1996, ch. 8) or Lewis (1995).)

least by some measures. Indeed, Meese and Rogoff (1983*b*) found that the root-mean-squared forecast errors for the random walk model are no longer consistently the lowest when one looks at two to three year forecast horizons. In an important paper, Mark (1995) finds that the superiority of the models at long horizons may actually be statistically significant; see also Chinn and Meese (1995). Even this relatively modest empirical connection between exchange rates and macroeconomic fundamentals, however, has been challenged. Killian (1997), for example, argues that Mark's asymptotic tests are biased in favour of predictability. Using a boot-strap method on Mark's data set, Killian finds no statistically significant evidence that monetary fundamentals help improve long-horizon predictability. Berkowitz and Giorganni (1997) argue that by imposing the *a priori* assumption that nominal exchange rates and monetary variables are co-integrated, Mark's approach errs on the side of overstating statistical significance. When they reformulate his test under the assumption of no co-integration, they fail to find any statistically significant evidence of improvement.

2. Why Do the Models Perform So Poorly?

What is one to make of the fact that researchers have such difficulties estimating macroeconomic exchange rate models? Do we not all believe that there must be some link between monetary fundamentals and major exchange rates, at least in the long run?[3] One obvious point, of course, is that a great many factors appear to buffet exchange rates, other than just money, income and interest rates. Measured at three-year intervals, the standard deviations of month to month changes in the yen/dollar and DM/dollar exchange rates have generally been in the range of 2.4% to 3.5% during the post-1974 floating rate era (see Rogoff (1999)), only slightly less than the volatility of major stock market indices. As Flood and Rose emphasise in their contribution to this symposium, the volatility of the exchange rate far exceeds the volatility of any standard measure of macroeconomic fundamentals. Even allowing for overshooting, which in principal can magnify the impact of macroeconomic variables on the exchange rate, most researchers and practitioners have concluded that short-term exchange rate volatility cannot possibly be attributed to macroeconomic factors. True, the difficulty of connecting asset prices to underlying fundamentals is hardly an embarrassment unique to exchange rate economists. Indeed, in many fields of finance, researchers are content to try to explain expected rates of change in asset prices, and do not even pretend to be able to explain levels.[4]

[3] The view that monetary shocks must be neutral in the long-run has been challenged recently. Obstfeld and Rogoff (1995) show that in an explicitly intertemporal sticky-price model, temporary money shocks typically result in short-term current account imbalances. Because of the resulting redistribution of world wealth, money shocks may have real effects that far outlast any price rigidities. Bergin and Feenstra (1998) argue that this effect may be quite significant empirically.

[4] See, for example, the extensive empirical literature on asset pricing surveyed in Campbell *et al.* (1997).

A second obvious problem is that money demand has been extremely unstable over the past two decades. Deregulation and innovation have been pervasive throughout the OECD, making the connection between any measure of money and prices a tenuous one.[5] Moreover, inflation rates across the United States, Germany and Japan have all converged downwards towards zero; this naturally makes it even more difficult to detect the effects of monetary policy differences on exchange rates. Last but not least, no major central bank today sets the money supply exogenously. Rather, as Taylor (1993) and others have argued, major central banks today typically use short-term interest rates to minimise a loss function depending on output and inflation. While one can in principle deal with this endogeneity of the money supply using an instrumental variables approach, the difficulty of finding valid instruments is well known, as is the sensitivity of alternative approaches to identifying monetary policy in vector autoregressions.

A third problem is that the law of one price, from which the doctrine of purchasing power parity is derived, often seems to hold mainly in the breech. It is true that there now is a large body of evidence supporting the view that shocks to PPP tend to dampen out over the long run. However, researchers have had to struggle with the question of why the rate of convergence seems to be so slow. In linear models, the half-life of deviations from PPP seems to be three to four years.[6] Since one normally thinks that the real effects of monetary shocks should have largely dissipated after one to two years, this seems like an inordinately long period. Of course, if the main sources of exchange rate disturbances are real (e.g., productivity) shocks, it would not be at all difficult to rationalise slow convergence to PPP. But then it would be hard to explain the very short-term volatility of exchange rates, which is usually presumed to be dominated by monetary and financial market shocks.

Rogoff (1996) suggests that the most plausible resolution of the 'Purchasing Power Parity Puzzle' is that there must be large frictions in goods markets, due to transport costs, information costs, and threatened or actual tariffs. As a consequence of these frictions, there may be a sizeable buffer within which exchange rates can move without producing an immediate response in most goods prices. Thus, convergence to PPP may appear to be very slow, when in fact it may be reasonably fast outside the non-convergence band. Recently, a number of authors, including Coleman (1995), O'Connell (1998), Obstfeld and Taylor (1997), and Michael *et al.* (1997), have all estimated non-linear models that attempt to allow for a nonconvergence band. Though this literature is still evolving and some technical issues remain (e.g., most of our measures of PPP deviations are relative to an arbitrary base year and not absolute), the early results are promising. Application of related techniques to nominal exchange rate models would seem like a worthwhile enterprise.

[5] Ball (1998), however, argues that there does appear to be a stable demand for money in the United States over the past ten years, albeit one with much lower income and interest rate elasticities than in preceding decades.

[6] See Froot and Rogoff (1995), or Rogoff (1996).

3. Where Do We Go From Here?

Do the difficulties that researchers have faced in estimating monetary exchange-rate models imply that monetary models have no relevance and should be abandoned? Certainly not. First of all, even if the models do not have much power in empirically explaining cross rates between the yen, dollar and the DM (euro), they have still proven extremely useful in explaining exchange rates across countries with significant current and/or potential future inflation differentials. For example, a central prediction of Dornbusch's classic (1976) 'overshooting' model is that a sustained unanticipated monetary tightening will lead to an appreciation of the real exchange rate and a rise in the real interest rate. This prediction has been borne out repeatedly during the past decade, as many countries throughout the world have moved from high inflation to low inflation environments via exchange rate pegs and other commitment devices. Moreover, monetary models have proven valuable in understanding the effects of major shifts in macroeconomic policy not only on the exchange rate, but on other variables such as employment and the current account.

In addition to any improvements that are gained by estimating non-linear models, one may also expect at least modest improvements in empirical exchange rate models as researchers begin to implement the 'New Open Economy Macroeconomics' models that have come to supplant older monetary models in the theoretical literature.[7] These newer models are far better equipped to handle government spending and productivity shocks than traditional open-economy macroeconomic models, and also embody a far more satisfactory treatment of dynamics and the current account. Sustained current account imbalances appear to have a strong empirical correlation with real exchange rates (see Obstfeld and Rogoff, 1996, ch. 10), and properly incorporating them into empirical exchange rate models may prove fruitful (see especially Bergin and Feenstra, 1998). The newer models also allow for a more sophisticated general equilibrium treatment of risk. Obstfeld and Rogoff (1998) show that the 'level' risk premium in the exchange rate can be a significant missing fundamental in monetary exchange rate equations, one that can be quite large (10% or more) and quite volatile. Still, although new open-economy macroeconomics models have many advantages for a variety of positive and normative questions, truly major progress on empirical nominal exchange rate modelling will probably follow only when economists have a better handle on factors which buffet financial markets more generally.

Finally, the linking of macroeconomics and politics has proven an extremely fruitful area of research over the past decade, and it is just possible that the explicit introduction of political factors may also strengthen the ability of macroeconomic models to predict exchange rates. Blomberg and Hess (1999) present some intriguing evidence suggesting political-economic models may indeed lead to better out-of-sample exchange rate forecasts than models based on macroeconomic factors alone. Again, though, the gains to introducing

[7] See, for example, Obstfeld and Rogoff (1996), ch. 10, or Corsetti and Pesenti (1997).

political factors are probably second-order compared to the broader problem of financial market volatility.

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