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The monetary model strikes back: Evidence from the world

Valerie Cerra *, Sweta Chaman Saxena [1]

International Monetary Fund, 700 19th Street N.W., Washington, DC 20431, USA

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ABSTRACT

We revisit the dramatic failure of monetary models in explaining exchange rate movements. Using the information content from 98 countries, we find strong evidence for cointegration between nominal exchange rates and monetary fundamentals. We also find fundamentals-based models very successful in beating a random walk in out-of-sample prediction.

1. Introduction

Monetary models of nominal exchange rate determination were a mainstay of international economics in the 1970s, and the key relationships continue to form an important part of current international macro models. These models appeared to fit in-sample empirical estimations fairly well. Nonetheless, the models were dealt a severe blow by the seminal work of Meese and Rogoff (1983). Using a set of post-Bretton Woods exchange rates for several major industrial countries, Meese and Rogoff showed that a simple random walk had more out-of-sample predictive power than the monetary models, even when the future realizations of the explanatory variables in the monetary models were used to generate the out-of-sample forecast. Subsequent authors tried to overturn these results, but any promising findings turned out to be fragile and the literature has remained pessimist about the link between exchange rates and monetary fundamentals (Frankel and Rose, 1995; Rogoff, 1999).

A recent resurgence of empirical work tries to evaluate exchange rate models using new methods for in-sample and out-of-sample evaluation. With advances in the econometrics of nonstationary data, in-sample analysis has turned to cointegration to look for long-run relationships between exchange rates and fundamentals. Evidence for cointegration has been mixed, with results depending on the country and sample used. For example, MacDonald and Taylor (1993) provide early favorable evidence for cointegration between nominal exchange rates and monetary fundamentals for the U.S. dollar–Deutche Mark exchange rate. Rapach and Wohar (2002) use data for 14 industrial countries that span as long as 115 years (1880–1995), and find some evidence of cointegration for 8 of the 14 countries. Very recent work focuses on using panel cointegration tests to take advantage of the power of using multiple country exchange rates and fundamentals. Husted and MacDonald (1998) find evidence of cointegrating relationships in panel data sets for the U.S. dollar, German mark and Japanese yen exchange rates using annual data for the recent floating experience. Motivated by the idea of cointegration between variables, the recent out-of-sample analysis examines whether the current deviation of the exchange rate from its long-run equilibrium is useful for predicting the future exchange rate returns (Mark, 1995; Mark and Sul, 2001).

This paper exploits the power of panel cointegration tests by including a broad country sample, which has a low degree of cross-sectional dependence. Although recent literature has made advances using panel cointegration, the country samples used tend to suffer from considerable cross-sectional dependence, in part because the panel data sets of industrial countries contain many highly linked EMS countries. For instance, over the period 1984–2004, the average pairwise correlation of exchange rate changes in Mark and Sul (2001) and Groen (2000) countries is above 0.65. In contrast, the average pairwise correlation of exchange rate changes in our broader data set of 98 countries is below 0.2. Thus, we exploit a larger sample with substantially more independent variation. We also take measures to control for even the low level of cross-sectional dependence in our

* Corresponding author. Tel.: +1 202 623 8596; fax: +1 202 589 8596.
E-mail addresses: vcerra@imf.org (V. Cerra), ssaxena@imf.org (S.C. Saxena).
[1] Tel.: +1 202 623 8728.

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dataset, using the most recent advances in controlling for cross-sectional dependencies in the cointegration tests. These methods include extracting a common time effect from the data and doing bootstrap trials that resample from the vector of correlated residuals.

The previous literature has largely ignored the information provided by a large set of countries. One reason for this neglect has been a concern that the exchange rate regime has been fixed for many non-industrial countries. We argue that the mix of exchange rate regimes in our country sample is no more an issue than for the extant literature, first because of the high frequency at which countries adjust their pegs in the recent decades, and second because there may be more independent flexibility for the broad sample of countries than for the industrial countries. The proportion of observations in our data sample in which the dollar exchange rate did not change from one year to the next is under 8%. Obstfeld and Rogoff (1995) point out that aside from a few minor tourist economies, oil sheikdoms, and heavily dependent principalities, only a very small number of fixed exchange rates survive intact for several years. Klein and Marion (1997) showed that the average duration of pegs in the Western Hemisphere countries was only 10 months. Second, the extant literature on industrial country exchange rates has often ignored the long stretches of links to the Deutche Mark in studying the "floating period." Indeed, Klein and Shambaugh (2006) show that pegged exchange rate regimes accounted for about 40% of the observations for industrial countries during the years 1973–2004. The long-span data in Rapach and Wohar (2002) cover not only the post-Bretton Woods period of floating exchange rates, but also long spells of fixed exchange rates during the gold standard and the Bretton Woods era. Against this background, our large data set has the advantage of providing considerably more observations of independent exchange rate adjustment than the previous studies, as evident from the low cross-sectional correlation of exchange rate changes.

A second problem in some panel cointegration tests is the assumption of a homogeneous slope coefficient. Mark and Sul (2001) check for cointegration in a panel of countries by testing the significance of the slope coefficient in a regression of the exchange rate return on the deviation of the exchange rate from its fundamental value:

$$\Delta s_{it} = \beta\left(f_{i,t-1} - s_{i,t-1}\right) + e_{it}$$

They estimate the model using a panel with controls for country and time effects. If the exchange rate, s, is cointegrated with the fundamentals, f, then the errors will be stationary, whereas the error will be nonstationary under the null hypothesis of no cointegration. However, they assume that the slope coefficient, β, is homogeneous across countries in the panel. If the homogeneity assumption is incorrect and β differs across countries, then the error will contain the term $(\beta_i - \beta)(f_{i,t-1} - s_{i,t-1})$, violating the consistency requirement that the regressors and errors are uncorrelated. The same issue arises in the Groen (2000) paper, which first estimates the cointegrating vector and then uses the Levin Lin (LL) panel unit root method to test the residuals for nonstationarity. The LL test assumes a homogeneous coefficient on the lag level of the residual, $\hat{\mu}_{it}$:

$$\Delta\hat{\mu}_{it} = \rho\hat{\mu}_{i,t-1} + \sum_{j=1}^{p} \phi_{ij}\Delta\hat{\mu}_{i,t-j} + \varepsilon_{it}$$

To address this issue, we employ recent panel methods that allow for heterogeneous adjustment coefficients in the alternative hypothesis of panel unit root tests.

We complement our in-sample cointegration tests with out-of-sample prediction analysis. We employ specifications and testing procedures that include both Meese and Rogoff's original out-of-sample fit method and the out-of-sample forecasts of exchange rate returns used in the more recent literature. For example, Mark and Sul use the current deviation of the exchange rate from its equilibrium value, as determined by the cointegrating relationship, to form forecasts of the change in the exchange rate between the current period and various future horizons. However, Engel and West (JPE, 2005) show that there should be very little forecastability of exchange rates based on current and past information if exchange rates behave like asset prices. That is, market expectations of future fundamentals, as derived from a current information set, will already be built into the exchange rate. They show that under reasonable assumptions the correlation between future exchange rate returns and current/past fundamentals is extremely low, typically below 0.1 for the most likely parameter calibrations. In contrast, Meese and Rogoff's out-of-sample fit method uses the realized future values of the fundamental variables. Future fundamentals incorporate future innovations, i.e., those that are unknown at the current time but subsequently impact exchange rate changes. Therefore, if the models are correct, actual future changes in fundamentals will be highly correlated with future changes in exchange rates. In principle, out-of-sample fit (using actual future outturns of fundamentals) should thus be a more powerful model evaluation method than the out-of-sample forecast (using only current information) method. Indeed, Meese and Rogoff's work generated such pessimism about exchange rate models precisely because the models work poorly in spite of being given the advantage of knowing the future fundamentals. Since this paper is the first attempt to examine the out-of-sample behavior of exchange rates and monetary fundamentals for a broad country sample, we take an agnostic stance and "let the data speak" for both testing procedures.

We also introduce a revised specification of the exchange rate model, which outperforms the other traditional models. That is, in addition to Meese and Rogoff's specification relating the level of the exchange rate to the level of the fundamentals, and Mark and Sul's specification relating the exchange rate return to the deviation of the exchange rate from its cointegrating equilibrium, we also provide a model specification of the *changes* in the exchange rate related to the *changes* in the fundamentals. This model is more robust to a structural break than the level specification. We also provide a test of the directional forecasting accuracy for out-of-sample evaluation in addition to the standard root mean squared error measure.

Our larger dataset of countries also provides other advantages to the out-of-sample analysis. We are able to do a long horizon forecast that avoids the size distortions and other statistical problems associated with overlapping observations. We use non-overlapping five year intervals by instead exploiting the large number of countries to gain observations. In addition, we compare fundamentals models to both the random walk and random walk with drift, and use the cross-country dimension to demonstrate the relationship between fundamentals and the drift rate in the random walk with drift model.

2. Structural specification and data

The structural specification centers on the relationship between the nominal exchange rate, money, and output relative to a numeraire country. These are the core variables in both flexible price (Frenkel–Bilson) and sticky price (Dornbusch–Frankel) monetary models.[2] Additional variables could include interest rates, expected inflation, and trade balances. However, market interest rates are often difficult to obtain for many emerging market and developing countries, and sometimes contain a large component of volatile risk premium that would need to be disentangled. In addition, nominal exchange rates in developing countries may depend on other factors, such as terms of trade. As in Mark (1995) and Mark and Sul (2001), we focus on the core set of monetary model fundamentals for the purpose of this

[2] See Frenkel (1976), Bilson (1978, 1979), Frankel (1979) and Dornbusch (1976).