International Review of Business Research Papers
Vol.3 No.2 June 2007, Pp. 278- 304

Meese and Rogoff's Puzzle Revisited

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Though the behavior of the exchange rate among major currencies has been tracked through structural models, Meese and Rogoff, among others, in their seminal work argue that a random walk model is superior to all competing structural models based on out-of-sample predictability power. This paper tries to shed light on Meese and Rogoff's puzzle by investigating the exchange rate behavior among G-7 currencies through extending their data from 1973 to 1981 up to 2005 and by inclusion of omitted variables. I compare Frankel-Bilson, Hooper and Morton, Overshooting, and an augmented model with the inclusion of omitted variables, with a random walk model. Based on root mean squared error (RMSE) and mean absolute error (MAE), in sharp contrast to the findings of Meese and Rogoff, the results of this paper support the failure of a random walk model compared with structural models. The results not only help us understand the role of fundamentals in explaining the exchange rate behavior, but also lent support to the belief that exchange rates are predictable.

Key Words: monetary transmission mechanism, foreign debt, foreign direct investment, Treasury bill rate, excess return, random walk, misspecification, interest rate parity condition, overshooting model, portfolio balance model.

Field of Research: International Finance

1. Introduction

Almost two decades after the seminal work of Meese and Rogoff on the exchange rate behavior, researchers still fail to outperform a random walk. Despite the studies carried out on the determinants of real exchange rate, a small portion of them has addressed the misspecification problem. One possible explanation for dismal forecasts of exchange rate models in the Meese and Rogoff's study is that structural models of exchange rates are misspecified; another explanation is attributable to the short time span.

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Many studies have tried to shed light on this issue by extending the data and by using different variables. Among them, Chinn Menzie and Ron Alquist (2006) examine the relative predictive power of the sticky price monetary model, uncovered interest parity, and a transformation of net exports and net foreign assets and find that interest rate parity condition holds better at long horizons. In sharp contrast to their finding, Cheung et al. (2002) reexamine different exchange rate models' performance at various forecast horizons, using different metrics, and find that none of fundamental models consistently outperforms a random walk. On the other hand, Brooks et al. (2001) survey the movements of the euro/dollar and the yen/dollar exchange rates and find that fundamentals like the current account and portfolio flows are the main determinants of exchange rates. Kilian and Taylor (2001) provide strong empirical evidence that the predictability power of the spot dollar exchange rate in OECD countries improves unambiguously as the forecast horizon is lengthened from one quarter to several years. However, Campbell and Clarida (1987), Floot and Rose (1985), Bleaney (1998), and Fair (1999), among others, argue that little explanatory power is found in the monetary or portfolio-balance models.

In fact, the question Meese and Rogoff have raised still remains controversial. Though many empirical studies have been carried out since the pioneering work of Meese and Rogoff, none of them has extended the data through 2005. In addition, most studies have used quarterly data, whereas using monthly data, as Meese and Rogoff choose in their original work, is superior because many financial and monetary variables adjust at intervals shorter than a quarter.

A useful approach to test the accuracy of Meese and Rogoff's results would be to investigate whether a structural model based on a larger sample would be able to outperform a random walk. In doing so, I extend their sample—from March 1973 through June 1981—to more than three decades, covering the period 1973:1-2005:12, to see if their results still remain robust. In fact, their sample period is too short to capture the sharp movements in financial variables in the mid-1980s and late1990s, much less to cover the Japanese recession, and the recent oil shocks.

To overcome these shortcomings, I replicate Meese and Rogoff's model to verify whether their results hold with my data. Then, I extend the time span to more than three decades to test whether the results still hold. One of the novel features of this study is that it pays particular attention to omitted variables─stock market channel─in the structural models. Indeed, if a random walk model fails to outperform structural models with the extension of data, the problem can be attributed to short time span covered in their study. But, if the inclusion of omitted variables with a longer time span leads to more accurate forecasts, then, one may conclude that the problem is attributable to both sampling error and misspecification problem.

The rest of this paper is organized as follows. Section II presents a brief review of the literature. Section III portrays the data and the co-integration tests. Section IV describes the methodology and analyses empirical results. Section V compares out-of-sample predictability power of a random walk with those of fundamental models. Finally, Section VI raps up and concludes.

2. Literature Review

The structural model developed by Meese and Rogoff can be summarized as follows:

$$s = a_0 + a_1(m - m^*) + a_2(y - y^*) + a_3(r_s - r_s^*) + a_4(\pi^e - \pi^{e*}) + a_5 \bar{TB} + a_6 \bar{TB}^* + u_t \quad (1)$$

Where *s* is the logarithm of the dollar price of the foreign currency, $(m - m^*)$ is the logarithm of the ratio of the U.S. to the foreign money supply, $(y - y^*)$ is the logarithm of the ratio of the U.S. to foreign real income, $(r_s - r_s^*)$ is the short-term interest rate differential measured by Treasury Bill Rates (TBR), $(\pi^e - \pi^{e*})$ is the expected long-run inflation differential, measured by long-term interest rate differentials; $\bar{TB}$ and $\bar{TB}^*$ represent the accumulated U.S., and foreign trade balances; and, finally, u_t is a disturbance term.

All of the models posit that, *ceteris paribus*, the exchange rate exhibits first-degree homogeneity in the relative money supply, or $a_1 = 1$. The Frankel-Bilson model assumes purchasing power parity constraints of $a_4 = a_5 = a_6 = 0$. The Dornbusch-Frankel model allows for slow domestic price adjustment and consequent deviations from Purchasing Power Parity (PPP), which sets $a_5 = a_6 = 0$. None of the coefficients is constrained to be zero in the Hooper-Morton model.

Meese and Rogoff conclude that the random walk model invariably has the lowest root mean squared error over all horizons and compared with all fundamental models. However, their time span is too short to cover the oil shocks in the mid 1980s, the high productivity growth of the Japanese economy in the late 1980s and early 1990s, the growing surplus in Japan's trade balance, the economic sluggishness associated with the post bubble period of the early 1990s, and the large capital and equity flows from the euro area to the United States in the 1990s, much less to cover the European Monetary System evolutions, the Japan's recession and the recent oil price shocks. Since Meese and Rogoff's seminal work, many studies have tried to shed light on this puzzle. In fact, if Meese and Rogoff's argument that the exchange rate follows a random walk is correct, then the strong policy implication for the U.S. Federal Reserve and the monetary authorities in other G-7 countries is that intervention in the foreign exchange market is futile. To see how others have reacted to the Meese and Rogoff's puzzle, I briefly review some of the empirical studies in the following section.

Cheung et al. (2002) predict the exchange rate behavior using a wider set of models that have been proposed in the last decade. The models are estimated in the first difference and the error correction specification. They use quarterly data for Canada, Germany, Japan, the United Kingdom, the United States, and Switzerland from 1973Q2 to 2000Q4. They implement the price level, relative price of nontradable goods, real interest rate, Debt/GDP ratio, terms of trade, and net foreign assets to estimate the Balassa-Samuelson effect. They also estimate a simple monetary and interest rate parity model with variables such as the difference in the money supply, real GDP, inflation, and interest rate differentials. Cheung et al. conclude that it is very difficult to find a structural model persistently beating a random walk. Their result supports the interest rate parity model at horizon of 20-quarters for the Canadian dollar/yen rate. They also suggest that the forecasts from the interest rate parity condition track the actual exchange rate movements extremely well during 1985-90 and 1993-97. The random walk model, however, forecasts better in other periods. They assert that the difference in the results stems from sharp upswings in the dollar during the mid 1990s. However, using out-of-sample forecasts, Cheung et al. give the maximum advantage to a random walk characterization. They conclude that using the RMSE, no model consistently outperforms a random walk. Nonetheless, with dimensions changed, certain structural models outperform a random walk model with statistical significance.

Kilian and Taylor (2001) provide strong empirical evidence for seven OECD countries that the predictability of the spot dollar exchange rate improves dramatically as the forecast horizon is lengthened from one quarter to several years. Using quarterly data for 1973Q1-1998Q4 on the spot nominal exchange rate, they are unable to accept the null hypothesis that a random walk model outperforms fundamental models at forecast horizons of two or three years at conventional significance levels for six out of seven OECD countries. Kilian and Taylor conclude that the closer the exchange rate is to its equilibrium value, the more random will be the observed movements in the spot exchange rates. However, for the forecast period of 1-12 months, they fail to outperform a random walk.

In another study, Johnston and Sun (1997) reexamine the role of long-run monetary factors in driving exchange rate movements. They use quarterly data for the period 1973Q3-1996.Q4, to explain the movements in the Deutsche mark, the Japanese yen, the pound sterling, and the Canadian dollar relative to the U.S. dollar. They find that exchange rate movements can be explained by fundamentals. The evidence is consistent with the view that monetary factors impinge upon the exchange rate movements in the long run. Johnston and Sun provide no empirical evidence that the current account balance affects the long-run exchange rate movements, although they find a short-run impact of the current account on the dynamics of the exchange rate. Their results suggest that a long-run significant relationship between exchange rates and such fundamentals as output, interest rates, and inflation exists. The exchange rate equation they represent outperforms a random walk model in out-of-sample forecast tests.

Lothian and Taylor (1994) use almost two centuries of data for the dollar/pound sterling (1791-90) and for the French franc/pound sterling (1803-90) real exchange rates. When they decompose the data, the early post-Bretton Woods portion of the data fails to reject a random walk for either exchange rate.

Engel (1992) analyzes eighteen exchange rates and finds that the prediction power of Markov models is no longer superior to that of a simple random walk, even though a random walk model performs better inside the sample.

Mussa (1979) argues that the spot exchange rate is approximately a random walk model and that most changes in exchange rates are unpredictable. Clarida (1987) discovers that very little of the variation in the real exchange rate can be explained by variations in the interest rate differentials.

In sum, the dispiriting conclusion of these studies that relatively little explanatory power is found in the monetary or portfolio-balance models or other fundamental can be attributed to different issues; one using annual or quarterly data, whereas using monthly data would be more appropriate, since many monetary variables adjust in intervals shorter than a quarter. Another important issue that has been dismissed in these studies is that they have ignored the asset market approach transmission mechanism, whereas asset returns particularly dividend yields, are important factors impinging upon the exchange rates.

On the other hand, many studies have succeeded to beat a random walk by using more appropriate fundamentals. Chinn Menzie and Ron Alquist (2006) examine the relative predictive power of the sticky price monetary model, uncovered interest parity, and a transformation of net exports and net foreign assets. They implement the Clark and West procedure for testing the significance of out-of-sample forecasts. The interest rate parity condition holds better at long horizons and the net exports variable does well in predicting exchange rates at short horizons in-sample. For out-of-sample forecasts, they find evidence that a proxy for Gourinchas and Rey’s measure of external imbalances outperforms a random walk at short horizons as do some of other models, although no single exchange rate model uniformly outperforms the random walk forecasts.

Brooks et al. (2001) reexamine the movements of the euro and the yen against the U.S. dollar, using a traditional approach. In order to have sufficiently long time series a synthetic value of the euro has been utilized extended back to January 1990, allowing the analysis of the euro/dollar rate over the period 1988Q1-2000Q3. Since the use of “synthetic” euro could lead to biases, they also use the Deutsche mark/dollar rate. For Japan the analysis is also undertaken over the same period. They use capital flows, stock returns, and relative growth expectations as independent variables. Their results suggest that net flows into U.S. equities, from the euro area are closely correlated with the level of stock prices, which appears to be a good measure of investors’ expectations.

Brooks et al. (2001) find that during the 1980s the current account was essential in explaining exchange rate movements between the dollar and the euro. However, during the 1990s an increase in portfolio flows into the United States led to the appreciation of the U.S. dollar. Their result for Japanese yen is quite different. Brooks et al. argue that the current account and portfolio flows, both important factors affecting the Japanese yen during the 1980s, have not been significant since the 1990s. They conclude that large inflows into U.S. equity markets, together with foreign direct investment flows, have helped finance the U.S. current account deficit, causing the dollar to appreciate. Conversely, large and initially unanticipated outflows from the euro area causes the euro's fall against other currencies. The results for the yen/dollar movements since 1988 are dramatically different from those for the euro, suggesting a more important role for the long-term interest rate differential and the relative current account positions than for equity flows.

To emphasize the role of fundamentals in exchange rate behavior, Lane and Milesi-Ferretti (2000) have investigated the relationship between international payments and the real exchange rate. Choosing a sample of industrial and middle-income developing countries, they find a positive and strong significant long-run relationship between the real exchange rate and net foreign assets for both groups of countries. Their finding, therefore, reinforces the existence of a powerful transfer effect, where the debtor countries have more depreciated real exchange rates. The evidence also suggests that the relative price of nontraded goods plays an important role in this long-run relationship.

To present evidence that fundamental models are superior to a random walk, MacDonald (1997) uses multilateral cointegration technique for the movements of dollar, mark, and the yen during 1974.Q1-1994.Q3. He implements such variables as, productivity growth, the fiscal balance, net foreign assets, the terms of trade, the real price of oil, the long-term real interest rate differential—measured by 10 years nominal bond yield—and the short-term interest rate differential—proxied by 3-month Treasury bill rates. His forecasts for the Deutsche mark and Japanese yen outperform a random walk model at all horizons. Finally, he finds that a system containing long-term interest rates dominates those with short-term interest rates. For the U.S. dollar, the long-term interest rate system outperforms a random walk at all horizons, although the general system with short-term interest rates outperforms the random walk only at horizon of three quarters.

In sum, though these studies have found that fundamental models outperform a random walk, most of them have emphasized variables such as net foreign assets, current account and equity flows, dismissing the stock market transmission channel, except a recent study developed by Chinn Menzie and Ron Alquist (2006). According to the stock market transmission channel, dividend yields play a dominant role in driving the exchange rate behavior. To overcome the deficiency of the empirical models this paper tries to cast light on Meese and Rogoff's puzzle through underlying the stock market transmission channel along with the extension of the data to see whether Meese and Rogoff's puzzle still remains controversial.

3. Data Description

The sample in this study covers the movements of the G-7 currencies against the U.S. dollar over the period 1973:1 through 2005:12. The analysis implements monthly data from the International Financial Statistics (IFS) issued by the International Monetary Fund (IMF). It is noteworthy that data on the U.S. foreign investment and foreign investment in the U.S. have been retrieved from the U.S. Federal Reserve website. I have chosen monthly data except those for current account and GDP to capture the movements in financial variables. Since the monthly data for GDP is not available, industrial production has been used as a proxy for this variable. Moreover, since the current account data are not available on a monthly basis, I have converted the quarterly to monthly data based on the uniform conversion of E-views. The monetary aggregate that I use for the money supply is M2. However, for the U.K., M4 replaces M2. In addition, since the data on net foreign assets are not available for France on a monthly basis, the quarterly data have been converted to a monthly basis.

The list of variables used in this paper includes the followings:

REER: real effective exchange rate
CPI: consumer price index
OILPRICE: world price of oil
INF: inflation rate based on CPI
FFR: federal fund rate
TBR: treasury bill rate
Discr: discount rate
LR: lending interbank rate
GBY: government bond yield
TB: trade balance
CA: current account
NFA: net foreign assets
GDP: gross domestic production in U.S. dollars
IP: industrial production
M2: money supply in U.S. dollars
Dummy: dummy variable for the years that the U.S. Federal Reserve has intervened in the foreign exchange market.
USFINV: U.S. foreign investment in other countries
FINVINUS: total foreign investment by other countries in the United States
DEBT: foreign debt
Divid: dividend yield
Excess: excess stock return compared with Treasury bill rate

Subscript 1 refers to the United States, 2 to the United Kingdom, 3 to France, 4 to Germany, 5 to Italy, 6 to Canada, and 7 to Japan.

The dummy variable equals one during the years that the Fed has intervened in the foreign exchange market and zero otherwise. Some studies, such as those conducted by Kaminsky and Lewis (1993), Klein and Rosengren (1991), and Lewis (1993), argue that the intervention channel for future monetary policy is ambiguous. However, Dominguez and Frankel (1993) find evidence on intervention effects through traditional portfolio channel. The results of the studies carried out by Catte, Galli, and Rebecchini

(1994) and Gruijters (1991) provide stronger evidence on the effects of daily interventions in the foreign exchange market. To capture such effects, dummy variables have been used in the structural models.

Similar to Meese and Rogoff and Brooks et al., I use the government bond yield as a measure of expected inflation. I also use the Treasury bill rate, the discount rate, and the interbank lending rate as short-term interest rate differentials when estimating structural models.

4. Methodology and Empirical Results

To test the robustness of Meese and Rogoff's results, first I replicate a random walk model and all the competing models for the time span covered in their study. I use the RMSE and MAE criteria to compare the predictability power of different models across different exchange rates. The results are mixed with my data. As presented in Table (1), the random walk model beats the competing models for the French franc, the Deutsche mark, the Italian lira, and the Japanese yen at 1-month horizon. In fact, with my data covering their period, the Frankel-Bilson model outperforms the competing models including a random walk for the pound. Table (2) presents the original results of Meese and Rogoff's study on the predictability of the $/mark, $/yen, and $/pound based on RMSE. They argue that for all exchange rates, except the Deutsche mark at horizon of 1 month, the random walk model beats all the competing models. The difference between our results may stem from the fact that Meese and Rogoff use Fair's instrumental variable technique to correct for first-order serial correlation and impose a restriction on the relative money supply to be equal to one, which creates bias in their estimated results. Whereas, in this study the first-order correlation has been addressed, no restriction has been imposed on the money supply and other coefficients.

Turning to MAE criteria, the estimated results with my data on the Meese and Rogoff's sample period, presented in Table (3), indicate that the random walk model beats the competing models for the Deutsche mark, the French franc, and the Japanese yen at 1-month horizon. However, the random walk model fails to beat the competing models for the pound sterling, the Canadian dollar, and the yen at horizons of 6 to 12 months, based on MAE criterion.

Indeed, the time span covered in Meese and Rogoff's study is too short to account for the evolvements of macroeconomic variables during the mid 1980s, the 1990s, and the new millennium. Therefore, I extend the data to more than three decades to capture these evolvements and compare the results of a random walk model with all competing models, including Bilson-Frankel, Dornbusch, and Hooper-Morton. Finally, I focus on the misspecification of structural models to see whether the accuracy of the out-of-sample forecasts improves when I include the omitted variables—stock market returns— in the standard fundamental models.

Table (4) portrays a driftless random walk model. Though the model is able to predict more than 95 percent of the spot exchange rate movements, the question raised is that whether this model is superior to other structural models according to out-of-sample accuracy forecasts criteria. I will address this question when I compare the forecasting power of a random walk model with those of other structural models.

In the following section, I estimate the Frankel and Bilson, the Dornbusch, and Hooper and Morton models for different currencies. It is notable that variables with asterisks, including *M**, *GDP** and *LR**, refer to the corresponding variables in the United States. The Frankel and Bilson model assumes that $a_4 = a_5 = a_6 = 0$ in equation (1). The results for this model with the extended data are reported in Table (5). The estimated results suggest that in accordance with MacDonald (1983) the coefficients on money supplies are negative and significant, except in France. Indeed, when money supply in other G-7 countries increases relative to the U.S., the interest rate falls, capital flows to the U.S., and the exchange rate depreciates relative to the U.S. dollar. As a result, we expect a positive coefficient on the money supply. However, as MacDonald argues, an unanticipated jump in the money supply may lead to appreciation of the exchange rate, underlining anticipation of future tightening.

The coefficients on GDP are significant and of the expected negative sign in all countries. As GDP in other G-7 countries increases relative to that of the U.S., the exchange rate appreciates, the dollar depreciates, and we expect a negative sign, as observed. The discount rate differential is significant for the Deutsche mark at 10% conventional significance level. The interbank lending rate differential is significant and of the expected negative sign for the pound sterling, the Italian lira, and the Canadian dollar. The Treasury bill rate differential is negative and statistically significant for the French franc. The only exception is Japan, where the Treasury bill rate is insignificant, albeit of the expected negative sign. Indeed, as interest rate increases in G-7 countries, capital flows from the U.S. to other G-7 countries, the exchange rate appreciates, the dollar depreciates, and we find a negative coefficient, as expected by theory. The results are in accordance with the interest rate parity condition.

The Dornbusch model assumes that $a_5 = a_6 = 0$ in equation (1). The results for the Dornbusch model presented in Table (6) suggest that all the coefficients on money supplies are significant and carry a negative sign except for the French franc. Monetary expansion is associated with the exchange rate appreciation, anticipating a future tightening. The coefficient on GDP or the industrial production ratio carries a negative sign as expected, except for the Deutsche mark, and is statistically significant except for the pound sterling. As industrial production in other G-7 countries increases relative to the U.S., the exchange rate appreciates, the dollar depreciates; we observe a negative sign as expected. The coefficients on the short-term interest rate differentials are statistically significant and of the expected negative sign for all currencies. Similar to Meese and Rogoff, I use the government bond yield and the lagged inflation as proxies for the expected inflation rate. The expected inflation differential is significant only for the Japanese yen and the Italian lira and of the expected positive sign for all currencies, except for the French franc. As inflation increases in other G-7 countries, capital flows to the U.S., the exchange rate depreciates, the dollar appreciates, and we find a positive sign. The coefficients for the Deutsche mark, the pound sterling, the French franc, and the Canadian dollar are insignificant, although they all have the expected positive sign.

Turning to Hooper and Morton model, which imposes no restrictions on the coefficients, as seen in Table (7), the coefficients on the relative money supply are statistically significant and have a negative sign. The coefficients on GDP and the industrial production ratio are of the expected negative sign and significant in all cases, except for the French franc. The short-term interest rate differentials are statistically significant and of the expected negative sign for all currencies, except the Canadian dollar. The expected inflation differential is significant only for the Japanese yen and the French franc. The U.S. trade balance is significant for the pound sterling and the Japanese yen, but not for other G-7 currencies. The coefficient on the domestic trade balance is significant for the pound sterling and the Canadian dollar. The coefficient on the trade balance ratio is statistically significant for the EMS currencies and the Japanese yen, although of the expected sign only for the Deutsche mark and the Japanese yen. An increase in the trade balance in G-7 countries is associated with an exchange rate appreciation; as a result, we observe a negative sign on this coefficient, as seen for the Deutsche mark and the Japanese yen.

To investigate the misspecification problem, I use the net foreign asset as a proxy for the current account net of changes in capital flows, since the exchange rate fluctuation is affected by capital flows and not all the flows are attributable to interest rate differentials. In fact, capital may flow between countries for other reasons including; political and economic risk, and capital restrictions.

“The fundamental balance of payments identity states that the current account, net financial flows and changes in foreign exchange reserves sums to zero, so that the following equation holds”.

$$CA = (\Delta FDIA - \Delta FDIL) + (\Delta EQA - \Delta EQL) + (\Delta DEBTA - \Delta DEBTL) + \Delta FX - \Delta KA - EO \quad (2)$$

Where Δ indicates the flows, *FDI, EQ*, KA and *DEBT* are the stocks of direct investment, portfolio equity investment, capital account transfers, and debt, respectively, with letter *A* indicating assets and the letter *L* indicating liabilities. Finally, EO represents errors and omissions. If we assume that errors and omissions reflect changes in the debt assets held by a country’s residents abroad, in line with the capital flow literature, we can assert that changes in net foreign assets reflect the current account balance (*CA)*, net of capital account (*KA)* transfers and, therefore, are appropriate proxies for changes in the current account, net of capital flows, such that the following equation holds:

$$\Delta NFA \cong CA + \Delta KA. \quad (3)$$

I use net foreign assets in the structural models to capture the effects of the current account, net of changes in capital flows. As observed in the emerging markets, large capital movements have significant impact on the value of currencies. Though the flow is not the only source of the exchange rate fluctuations; it can enhance the traditional models dramatically.

To test the existence of a long-run relationship between the real effective exchange rate, and economic fundamentals including the net foreign assets, I use the Johansen cointegration technique. The results for different currencies are summarized in Tales (8-11).

The cointegration test between the real effective exchange rate, the relative money supply, relative GDP, interest rate differentials, expected inflation, the current account, and net foreign assets fails to reject the null of the existence of a long-run relationship between the real exchange rate and fundamentals in G-7 countries. The results are not reported for Japan and Italy because they show a near-singular matrix for these variables. However, four cointegration equations for the Canadian dollar, three for the pound sterling, two for the Deutsche mark, and one for the French franc exists at 5% significance level.

In fact, the traditional fundamental models have been misspecified in the sense that they ignore the capital flows embedded in net foreign assets, whereas equity portfolio flows played a dominant role in the composition of capital flows to the United States in the 1990s. Meese and Rogoff fail to beat a random walk, not only due to the short span of time but also due to the fact that structural models have simply ignored the capital flows as the main determinant of the exchange rate. In the following section, I compare the out-of-sample forecasts of the structural models with a random walk model when capital flows measured by net foreign assets, foreign direct investment, and foreign debt are augmented to the model. I also add the oil price to capture the effects of supply shocks. Finally, as proposed by Ang and Beakert (2001), Kim and Roubini (2000) Garrett and Priestley (2000), and McNelis (1993), among others, the stock market returns, measured by dividend yields and excess returns have been embedded in the model to capture the effects of equity flows.

With the inclusion of newly introduced variables (Table 12), the coefficient on the relative money supply is negative and statistically significant for all currencies except that of the pound sterling. The coefficient on GDP or industrial production ratio is statistically significant and of the expected negative sign, except for the French franc and the Deutsche mark. The GDP ratio magnitude is greater than the relative money supply for the pound, the Italian lira, and the Japanese yen, highlighting the importance of real factors in driving the exchange rate.

Prima facie, the coefficient on short-term interest rate differential is negative and statistically significant for all currencies except for the pound sterling and the Japanese yen. The trade balance ratio is statistically significant in all cases and of the expected negative sign for the Deutsche mark and the Japanese yen. The coefficients on net foreign assets are significant for all currencies except the pound sterling and the Italian lira. However, the sign is negative, as expected, only for the Deutsche mark and the Canadian dollar. As net foreign assets increases, the exchange rate appreciates, the dollar depreciates, and we expect a negative sign, as observed for the Deutsche mark and the Canadian dollar. The oil price is significant only in the United Kingdom as the main oil producer.

The foreign debt has been included only for the French Franc because of data limitations. The coefficient on the net foreign debt is statistically significant and of the expected negative sign. As foreign debt increases the exchange rate appreciates, the dollar depreciates; we observe a negative sign, consistent with theory. Stock market returns, measured by dividend yield and excess returns, are statistically significant for all currencies. Foreign investment in the United States has been significant for the movements of the Deutsche mark, though of the unexpected sign. As foreign investors, invest more in the United States, the dollar appreciates and we expect a positive sign. Meanwhile, the ratio of the U.S. investment abroad to foreign investment in the U.S. is statistically significant for the Italian lira and of the expected positive sign. As the U.S. investment in other countries, increases the exchange rate appreciates and we observe a positive sign.

The dummy variable has been used in all equations, though the results prove that it is insignificant. In other words, it resembles that the Fed’s intervention in the foreign exchange market does not seem to matter for the exchange rate movements of the G-7 currencies.

5. Out of sample predictability power of a random walk model

A random walk model is compared with all competing structural models based on the out-of-sample forecasting accuracy criteria in Tables (13) and (14). All the models are estimated with monthly data. The starting point for the forecasts is 1995:1, when the Fed started to intervene in the foreign exchange market by selling and buying foreign currencies. Forecasts are generated at horizons of 1, 6, and 12 months, similar to Meese and Rogoff's study.

The out-of-sample accuracy is measured by two criteria; root means squared error (RMSE) and mean absolute error (MAE), which are defined as follows:

Mean absolute error $= \sum_{s=0}^{N-1} \left| F(t+s+k) - A(t+S+k) \right| / N_k$, and (4)

Root mean square error $= \{ \sum_{s=0}^{N-1} [F(t+s+k) - A(t+s+k)]^2 / N_k \}^{1/2}$. (5)

Based on the results presented in Table (13), the random walk model fails to outperform the structural models including; Bilson-Frankel, Dornbusch, and Hooper-Morton model not only for short horizons but also over the medium and long-term forecast horizons. Interestingly enough, the augmented structural model with the inclusion of omitted variables beats all the competing models for the Deutsche mark, the Italian lira for short horizon, and for the Japanese yen, and pound sterling in the long-run horizons based on the RMSE criteria.

The results for other structural models are mixed depending on the length of the horizon and on the currency. For example, the Frankel-Bilson model outperforms all competing models for the pound sterling at 1-month horizon, for the French franc over all horizons, for the Canadian dollar and Italian lira over the long horizons, supporting the interest rate parity condition.

Table (14) compares the results of a random walk model with competing models, based on MAE criteria. Again, the results support the failure of a random walk model. For the Deutsche mark, the Japanese yen, and the Italian lira, the augmented structural model beats all competing models based on mean absolute error (MAE). Among other structural models, the best forecast depends on the length of the forecast horizon and the currency. For example, for the French franc, the Frankel-Bilson model is superior to other structural models over all horizons, and for the Canadian dollar, the Frankel-Bilson model beats other structural models in the medium and long run. The evidence for the exchange rate overshooting model can be found for the Canadian dollar at 1-month horizon. Indeed, the results support the importance of stock market transmission channel in driving the exchange rate among G-7 currencies.

The random walk model invariably has the highest root mean squared errors and mean absolute errors over all horizons and across all currencies. In other words, one can unambiguously assert that all structural models outperform a random walk, when the data are extended and when the structural model is augmented to capture the stock market channel and other omitted variables.

6. Conclusion

To investigate the Meese and Rogoff's puzzle this paper tries to cast light on the structural models developed in the literature not only by extending the data but also by inclusion of omitted variables in the structural models. Indeed, one of the novel features of this paper is that it attempts to improve the forecasting power of monetary models, not only by extending the data, but also by highlighting the misspecification problem—an issue that has rarely been addressed in the current literature. In doing so, I have re-estimated a random walk model and all the competing fundamental models with extension of Meese and Rogoff’s data from 1973:3-1981:6 to 2005:12, not only for the pound sterling, the Japanese yen, and the Deutsche mark as in Meese and Rogoff’s original work, but also for the French franc, the Canadian dollar, and the Italian lira. Based on out-of-sample predictability power of estimated models for horizons of 1, 6, and 12 month, and choosing 1995:1 as the starting point for the forecasts, the results support the failure of a random walk model.

I provide strong empirical evidence that the predictability of the spot exchange rate models improve dramatically for the G-7 currencies as the sample period is extended from one decade to more than three decades. In fact, Meese and Rogoff’s failure to outperform a random walk model is attributable to both short time span and misspecification of the structural models. Indeed, many macroeconomic variables have been smooth during the post-Bretton Woods era, covered in Meese and Rogoff's study; whereas we observe many shocks, including oil shocks, productivity shocks, and supply shocks in the mid-1980s and early 1990s, leading to dramatic changes in financial and monetary variables, which are beyond the scope of the period under investigation in Meese and Rogoff's original work. Second, I show that the predictability power of the structural model improves dramatically when stock market transmission mechanism is included in the structural model. In sum, the results suggest that, for all currencies, the predictability power of fundamental models outperforms a simple random walk model when the data are simply extended from nine years to more than three decades and when more appropriate variables are included, underlining the misspecification problem.

Indeed, nominal exchange rates can be reasonably explained by bilateral economic fundamentals. Interestingly enough, inclusion of omitted variables, such as stock market returns and net foreign assets—as a proxy for the current account net of capital flows—dramatically improves the predictive power of fundamental models especially for the Deutsche mark, the Japanese yen, and the Italian lira at all horizons, and for the pound sterling at long horizon. For the Deutsche mark, the Japanese yen, and the Italian lira, the augmented structural model with the inclusion of omitted variables beats all the competing models, including the interest rate parity condition, overshooting, and portfolio-balance models. However, for the pound sterling, the augmented structural model with inclusion of previously omitted variables beats all the competing models only over long-run horizon. The results therefore contradict the perceived wisdom that exchange rates are random walks and cannot be predicted.

The random walk model almost invariably has the highest root mean squared errors and mean absolute errors over all horizons and across all currencies. It can be unambiguously argued that all structural models outperform the random walk model with the extension of data. The results suggest that when the data are extended to cover the oil shocks, the high productivity growth of the Japanese economy in the late 1980s, the growing surplus in Japan's trade balance, the bubble period of the late 1980s, the recession associated with the post bubble period of the early 1990s, the large capital and equity flows from the euro area to the U.S. in the 1990s, and the oil shock in the new millennium all structural models outperform a random walk based on RMSE and MAE criteria. In fact, Meese and Rogoff would never have confronted with the random walk puzzle if they had covered a longer time span to capture the sharp fluctuations of the macroeconomic fundamentals in the mid 1980s and late 1990s.

The empirical results of this paper indicate that simply extending the data from one decade to three decades improves the predictability power of the fundamental models based on RMSE and MAE criteria dramatically. Another interesting finding is that with the inclusion of previously omitted variables—including stock market returns and net foreign assets— the predictability power of structural models improves substantially in a way that not only outperforms a random walk, but also beats all other structural models, including interest rate parity, overshooting, and portfolio-balance models, for major currencies—the Deutsche mark, the Japanese yen, the Italian lira. The results suggest that more efforts should be made to set-up the structural exchange rate models more appropriately, exploiting all factors that have recently been found to impinge upon the exchange rates

The empirical results in this paper not only help us understand the role of fundamentals in explaining the exchange rate behavior, but also lent support to the belief that exchange rates are predictable. Indeed, both the extension of the data and inclusion of the main factors that affect the exchange rate, especially capital flows, dramatically improve the forecasting accuracy of the structural models. The empirical results support the existence of a long-run relationship between the stock market returns and current account net of capital flows—proxied by net foreign assets—on the one hand and the real effective exchange rate behavior on the other hand, underlining the importance of capital account controls on the exchange rate movements. In fact, as observed in the East Asia emerging market crisis, countries that liberalize their capital accounts without paying attention to its pre-requirements, and the sequencing of financial liberalization, may confront with irreversible losses and depreciation of their currencies.

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Appendix

Table 1. The results of a random walk forecasts compared with structural models, 1973:3-1981:6.

Exchange rate	Horizon	Random Walk	Frankel-Bilson	Dornbusch Overshooting	Hooper-Morton
$/PS	1 month	0.082	**0.036**	0.036	0.037
	6 months	0.107	**0.065**	0.070	0.070
	12 months	0.113	**0.062**	0.064	0.064
$/FF	1 month	**0.005**	0.052	0.083	0.085
	6 months	**0.066**	0.180	0.268	0.273
	12 months	**0.055**	0.278	0.478	0.484
$/DM	1 month	**0.006**	0.029	0.023	0.024
	6 months	**0.007**	0.056	0.022	0.023
	12 months	**0.018**	0.102	0.034	0.036
$/IL	1 month	**1.192**	19.09	9.489	25.85
	6 months	23.68	71.84	**13.35**	66.39
	12 months	**21.67**	138.5	42.57	83.62
$/CD	1 month	0.032	**0.020**	**0.020**	**0.020**
	6 months	0.049	0.024	0.025	**0.023**
	12 months	0.062	0.030	0.032	**0.029**
$/JY	1 month	**2.462**	3.588	2.669	2.686
	6 months	4.606	3.752	2.464	**2.416**
	12 months	9.491	**3.116**	3.825	3.743

Table 2. The results of a random walk forecasts compared with structural models, by Meese and Rogoff

Exchange rate	Horizon	Random Walk	Frankel-Bilson	Dornbusch Overshooting	Hooper-Morton
$/PS	1 month	**2.56**	2.82	2.90	3.03
	6 months	**6.45**	8.90	8.88	9.08
	12 months	**9.96**	14.62	13.66	14.57
$/JY	1 month	**3.68**	4.11	4.40	4.2
	6 months	**11.58**	13.38	13.94	11.94
	12 months	**18.31**	18.55	20.41	19.20
$/DM	1 month	3.72	**3.17**	3.65	3.50
	6 months	**8.71**	9.64	12.03	9.95
	12 months	**12.98**	16.12	18.87	15.69

Table 3. The results of a random walk forecasts compared with structural models, based on MAE

Exchange rate	Horizons	Random Walk	Frankel-Bilson	Dornbusch Overshooting	Hooper-Morton
$/PS	1 month	0.075	0.029	**0.028**	0.029
	6 months	0.103	**0.059**	0.063	0.064
	12 months	0.108	**0.056**	0.057	0.057
$/FF	1 month	**0.005**	0.038	0.066	0.065
	6 months	**0.055**	0.151	0.224	0.228
	12 months	**0.046**	0.246	0.416	0.421
$/DM	1 month	**0.006**	0.026	0.018	0.019
	6 months	**0.006**	0.052	0.016	0.017
	12 months	**0.012**	0.090	0.027	0.029
$/IL	1 month	**0.855**	18.64	7.962	25.83
	6 months	20.05	59.19	**11.05**	58.17
	12 months	**19.18**	116.74	32.34	77.21
$/CD	1 month	0.027	**0.017**	0.018	0.017
	6 months	0.046	**0.021**	0.022	**0.021**
	12 months	0.058	0.028	0.030	**0.027**
$/JY	1 month	**2.356**	3.544	2.666	2.683
	6 months	3.800	3.116	1.999	**1.951**
	12 months	7.647	5.207	2.921	**2.824**

Table 4. The random walk model results for the G-7 currencies, 1973:1-2005:12.

Variable	$/PS	$/FF	$/DM	$/IL	$/CD	$/JY
REER(-1)	0.97 (152.69)	0.97 (67.38)	0.96 (66.81)	0.96 (62.46)	0.99 (175.46)	0.97 (95.13)
AR (1)	0.35 (7.01)	0.27 (5.02)	0.31 (5.44)	0.36 (6.35)	0.14 (2.58)	0.32 (6.21)
Adjusted R-squared	0.95	0.97	0.97	0.97	0.96	0.98
Durbin-Watson	1.91	1.96	1.97	1.96	1.98	1.95
Log likelihood	809.31	698.23	684.72	722.07	1079.07	747.88

Table 5. The Frankel-Bilson model results for the G-7 currencies, 1973:1-2005:12.

Variable	\$/PS	\$/FF	\$/DM	\$/IL	\$/CD	\$/JY
(M / M^*)	-2.54 (-1.85)	0.19 (1.72)	-1.73 (-2.59)	-0.73 (-3.46)	-0.49 (-1.65)	-0.47 (-2.37)
(GDP / GDP^*)	-1.45 (-2.3.)	-4.39 (-7.24)	-1.23 (-1.96)	-1.23 (-3.76)	-2.23 (-4.36)	-2.56 (-3.43)
$(Discr - Discr^*)$			-0.03 (-2.24)			
$(LR - LR^*)$	-0.06 (-2.34)			-0.08 (-2.46)	0.02 (2.22)	
$(TBR - TBR^*)$		-0.03 (-2.23)				-0.49 (-0.98)
AR (1)	0.76 (96.82)	0.84 (74.23)	0.98 (173.45)	0.97 (52.63)	0.96 (234.9)	0.895 (29.65)
Adjusted R-squared	0.96	0.97	0.95	0.95	0.99	0.97
Durbin-Watson	2.24	2.29	2.30	2.26	2.17	2.39
Log likelihood	439.64	564.78	534.48	452.29	1234.77	786.47

Table 6. The Dornbusch model results for the G-7 countries, 1973:1-2005:12.

Variable	\$/PS	\$/FF	\$/DM	\$/IL	\$/CD	\$/JY
(M / M^*)	-3.54 (-9.77)	0.094 (0.46)	-3.29 (-11.45)	-0.93 (-2.74)	-1.26 (-5.43)	-3.24 (-13.11)
(GDP / GDP^*)		-2.69 (-3.72)		-2.87 (-6.57)		
(IP / IP^*)	-0.32 (0.56)		0.56 (1.72)		-0.78 (-2.32)	-0.94 (-0.67)
$(LR - LR^*)$	-0.07 (-1.95)			-0.08 (-1.97)	0.06 (2.24)	-0.085 (-3.24)
$(TBR - TBR^*)$		-0.03 (-1.75)	-0.06 (-1.98.)	-0.086 (-3.42)		
$(GBY - GBY^*)$			0.07 (0.96)	0.06 (1.69)		0.062 (1.72)
$(\pi - \pi^*)$	0.019 (0.86)	-0.04 (-1.06)			0.09 (1.24)	
AR (1)	0.99 (113.3)	0.85 (42.97)	0.94 (139.56)	0.83 (146.81)	0.98 (223.51)	0.95 (168.24)
Adjusted R-squared	0.96	0.97	0.96	0.97	0.97	0.95
Durbin-Watson	2.32	2.21	2.27	2.16	2.04	2.22
Log Likelihood	561.36	654.31	693.47	624.57	816.94	726.32

Table 7. Hooper-Morton model results for the G-7 countries during 1973:1-2005:12

Variable	$/PS	$/FF	$/DM	$/IL	$/CD	$/JY
(M/M^*)	-2.23 (-5.43)	-2.17 (-9.23)	-3.85 (-11.36)	-0.74 (-2.26)	-1.46 (-5.37)	-1.65 (-4.32)
(GDP/GDP^*)	-1.59 (-1.60)			-2.25 (-3.36)		-3.27 (-4.93)
(IP/IP^*)		-0.076 (-0.09)	0.58 (1.92)		-0.92 (-2.84)	
$(Discr - Discr^*)$			-0.08 (-2.76)			
$(LR - LR^*)$	-0.064 (-1.97)					
$(TBR - TBR^*)$		-0.064 (-1.86)		-0.093 (-2.45)	0.042 (3.18)	-0.084 (-0.94)
$(GBY - GBY^*)$	-0.04 (-0.93)			0.026 (1.39)		
$(\pi - \pi^*)$		-0.09 (-2.54)	-0.004 (-0.95)		0.061 (1.45)	-0.023 (-2.75)
TB	-1.25E-06 (-3.45)				1.8E-06 (1.35)	
(TB/TB^*)		0.057 (1.76)	-0.003 (-1.61)	2.56 (3.29)		-1.43 (-3.98)
AR (1)	0.86 (95.63)	0.97 (71.94)	0.98 (186.50)	0.97 (128.23)	0.93 (356.48)	0.95 (30.44)
Adjusted R-squared	0.97	0.95	0.97	0.94	0.93	0.97
Durbin-Watson	2.31	2.17	2.22	2.13	2.17	2.26
Log likelihood	475.82	527.63	654.18	624.72	894.32	584.92

Table 8. Co-integration test among the pound sterling and economic fundamentals

Variable	Eigenvalue	Trace Statistic	5% critical value	1% critical value	L.R. cointegration
$REER_2$	0.28	150.67	124.24	133.57	3
$(M4_2 / M4_{1)}$	0.23	105.88	94.15	103.18	3
(IP_2 / IP_1)	0.21	68.73	68.52	76.07	3
$(TBR_2 - TBR_1)$	0.11	36.23	47.21	54.46	3
$(GBY_2 - GBY_1)$	0.08	20.14	29.68	35.65	3
(TB_2 / TB_1)	0.05	7.72	15.41	20.04	3
NFA	0.004	0.57	3.76	6.65	3

Table 9. Cointegration test between the French franc and economic fundamentals

Variable	Eigenvalue	Trace Statistic	5% critical value	1% critical value	L.R. cointegration
$REER_2$	0.26	156.01	124.24	133.57	1
$(M4_2 / M4_{1)}$	0.11	82.12	94.15	103.18	1
(IP_2 / IP_1)	0.09	53.55	68.52	76.07	1
$(TBR_2 - TBR_1)$	0.05	29.51	47.21	54.46	1
$(GBY_2 - GBY_1)$	0.04	15.26	29.68	35.65	1
(TB_2 / TB_1)	0.013	4.87	15.41	20.04	1
NFA	0.006	1.59	3.76	6.65	1

Table 10. Co-integration test between the Deutsche mark and economic fundamentals

Variable	Eigenvalue	Trace Statistic	5% critical value	1% critical value	L.R. cointegration
$REER_2$	0.24	174.10	124.24	133.57	2
$(M4_2 / M4_{1)}$	0.11	96.11	94.15	103.18	2
(IP_2 / IP_1)	0.087	62.86	68.52	76.07	2
$(TBR_2 - TBR_1)$	0.072	37.50	47.21	54.46	2
$(GBY_2 - GBY_1)$	0.036	16.77	29.68	35.65	2
(TB_2 / TB_1)	0.021	6.41	15.41	20.04	2
NFA	0.001	0.48	3.76	6.65	2

Table 11. Co-integration test between the Canadian dollar and economic fundamentals

Variable	Eigenvalue	Trace Statistic	5% critical value	1% critical value	L.R. cointegration
$REER_2$	0.21	188.50	124.24	133.57	4
$(M4_2 / M4_{1)}$	0.09	107.57	94.15	103.18	4
(IP_2 / IP_1)	0.07	73.48	68.52	76.07	4
$(TBR_2 - TBR_1)$	0.06	47.39	47.21	54.46	4
$(GBY_2 - GBY_1)$	0.05	24.95	29.68	35.65	4
(TB_2 / TB_1)	0.02	7.29	15.41	20.04	4
NFA	0.0009	0.32	3.76	6.65	4

Table 12. The augmented structural model with inclusion of omitted variables, 1973:1-2005:12

Variable	\$/PS	\$/FF	\$/DM	\$/IL	\$/CD	\$/JY
(M / M^*)	-0.23 (-0.95)	-2.49 (-9.78)	-2.35 (-4.78)	-0.48 (-2.56)	-1.49 (-6.21)	-1.04 (-3.56)
(GDP / GDP^*)	-4.06 (-3.22)			-2.17 (-4.59)		-2.21 (-6.43)
(IP / IP^*)		0.26 (0.58)	0.41 (1.62)		-0.54 (-2.23)	
$(TBR - TBR^*)$		-0.09 (-1.54)	-0.064 (-2.56)	-0.007 (-2.23)	0.004 (1.97)	
$(Discr - Discr*)$						0.004 (0.65)
$(LR - LR^*)$	0.0083 (0.75)					
$(GBY - GBY^*)$	-0.006 (-1.65)		0.004 (1.26)	0.006 (1.23)		
$(\pi - \pi^*)$		-0.035 (-2.76)			0.003 (1.32)	-0.004 (-1.98)
(TB / TB^*)	0.56 (1.72)	0.024 (1.97)	-0.004 (-1.57)	3.42 (2.75)		-1.24 (-2.36)
TB					1.24E-05 (1.37)	
NFA	0.004 (1.23)	5.21E-05 (1.75)	-0.0005 (-1.96)	0.007 (0.34)	-0.004 (-2.66)	
OILPRICE	0.004 (1.79)				0.005 (1.19)	
DEBT		-6.36E0-5 (-1.94)				
$(Divid_i / Divid_1)$	0.08 (3.65)		-0.08 (-1.65)			
$(EXCESS / EXCESS^*)$		3.04E-05 (1.53)		-2.19E-05 (-3.24)	-4.3E-05 (-1.75)	0.008 (2.23)
FINVINUS			-0.0004 (-1.76)			
USFINV/FINVINUS				0.08 (1.97)		
USFINV						-0.002 (-0.45)
Dummy			-0.03 (-1.2)	-0.04 (0.96)		
AR (1)	0.76 (12.94)	0.78 (94.51)	0.94 (147.86)	0.94 (174.32)	0.98 (215.1)	0.94 (23.57)
Adjusted R-squared	0.96	0.97	0.95	0.96	0.97	0.95
Durbin-Watson	2.27	2.21	2.14	2.29	2.19	2.32
Log likelihood	324.69	214.26	724.56	564.32	754.98	641.95

Table 13. Root means squared forecast errors for G-7 currencies for different models at different horizons

Exchange rate	Horizons	Random Walk	Frankel-Bilson	Dornbusch Overshooting	Hooper-Morton	Augmented model
$/PS	1 month	0.032	**0.003**	0.006	0.007	0.004
	6 months	0.047	**0.014**	0.017	0.019	0.017
	12 months	0.034	0.020	0.021	0.019	**0.018**
$/FF	1 month	0.198	**0.071**	0.084	0.152	0.092
	6 months	0.482	**0.181**	0.183	0.320	0.221
	12 months	0.503	**0.214**	0.218	0.347	0.251
$/DM	1 month	0.071	0.027	0.029	0.029	**0.018**
	6 months	0.169	0.083	0.097	0.096	**0.074**
	12 months	0.166	0.092	0.096	0.098	**0.077**
$/IL	1 month	41.23	26.07	27.09	28.57	**23.49**
	6 months	45.18	35.70	27.91	**27.60**	28.05
	12 months	71.13	**28.50**	30.17	29.84	29.36
$/CD	1 month	0.024	0.017	0.013	0.014	**0.012**
	6 months	0.025	**0.014**	0.018	0.019	0.016
	12 months	0.034	**0.015**	0.025	0.027	0.017
$/JY	1 month	2.260	1.048	1.572	**0.771**	0.676
	6 months	9.657	6.055	6.461	5.652	**5.131**
	12 months	10.89	5.062	5.053	4.591	**4.192**

Table 14. Mean absolute forecast errors for G-7 currencies in different models at different horizons

Exchange rate	Horizons	Random Walk	Frankel-Bilson	Dornbusch Overshooting	Hooper-Morton	New augmented Model
$/PS	1 month	0.033	**0.003**	0.004	0.006	0.004
	6 months	0.043	**0.013**	0.015	0.014	0.016
	12 months	0.031	0.017	0.016	**0.018**	0.017
$/FF	1 months	0.194	**0.070**	0.071	0.14	0.09
	6 months	0.450	**0.164**	0.165	0.30	0.21
	12 months	0.484	**0.198**	0.199	0.32	0.22
$/DM	1 month	0.069	0.028	0.027	0.026	**0.012**
	6 months	0.162	0.079	0.088	0.084	**0.069**
	12 months	0.161	0.085	0.096	0.095	**0.070**
$/IL	1 month	41.76	18.59	24.25	24.23	**16.89**
	6 months	41.47	28.25	22.51	22.07	**21.68**
	12 months	64.76	**21.66**	26.26	25.78	24.62
$/CD	1 month	0.014	0.016	**0.011**	0.013	0.014
	6 months	0.022	**0.011**	0.016	0.017	0.015
	12 months	0.031	**0.013**	0.022	0.025	0.017
$/JY	1 month	2.10	1.12	1.54	0.647	**0.58**
	6 months	12.28	5.25	5.72	4.85	**4.75**
	12 months	8.57	4.15	3.91	3.56	**3.26**