Global Interest Rates, Currency Returns and the Real Value of the Dollar

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The real value of the U.S. dollar has fluctuated widely during the global financial crisis and its aftermath. Beginning in early 2008 through early 2009, the dollar strengthened against most currencies, but then has weakened considerably in the intervening months. We propose a decomposition of the forces driving the real exchange rate into a long-run real interest rate component and a residual "level" risk premium component. If real interest rates in the U.S. rise relative to its partners, the value of the dollar should strengthen. Likewise, if the level risk premium on foreign interest-bearing assets rises, the dollar should also strengthen. We find that little of the recent movements in the dollar are directly attributable to the real interest component, suggesting that most of the movements are due to the residual risk premium component.

There is a large and diverse literature that affords a role to real interest differentials and to risk premiums in determining the real value of a currency. Our approach is almost purely definitional. The only assumptions we rely on are those of stationarity – of the real exchange rate and the U.S.-foreign real interest differential. Specifically, let q_t denote the log of the real exchange rate, defined as the foreign consumer price level (converted into dollar terms by the nominal exchange rate) divided by the U.S. consumer price level. A decrease in q_t represents a real appreciation of the dollar. As well, let $r_t^{US} \equiv i_t^{US} - E_t \pi_{t+1}^{US}$ be the ex ante U.S. real interest rate, where i_t^{US} represents the nominal interest rate on one-month Eurodollar deposits, and $E_t \pi_{t+1}^{US}$ is expected inflation in the U.S. Similarly, $r_t^* \equiv i_t^* - E_t \pi_{t+1}^*$ is the foreign real interest rate.

We can then define the excess return on foreign interest-bearing assets as:

(1) $\lambda_t \equiv r_t^* - r_t^{US} + E_t q_{t+1} - q_t$.

The relative foreign to U.S. real return equals the difference between foreign and U.S. real interest rates, plus the expected real depreciation of the dollar, $E_t q_{t+1} - q_t$.

We take the no-bubbles forward solution to equation (1), and use the stationarity of the real exchange rate so that the limit as $j \to \infty$ of $E_t q_{t+j}$ is $\bar{q}$, the unconditional mean of q_t:

(2) $$q_t = -R_t - \Lambda_t + \bar{q}, \; R_t \equiv \sum_{j=0}^{\infty} E_t (r_{t+j}^{US} - r_{t+j}^*), \;\; \Lambda_t \equiv \sum_{j=0}^{\infty} E_t \lambda_{t+j}.$$

In equation (2), we make the mild assumption that the present values converge. We call R_t the long-run real interest differential, Λ_t the level risk premium.

According to equation (2), holding Λ_t constant, an increase in R_t implies a real dollar appreciation: when the expected sum of all current and future U.S. real interest rates rises relative to the foreign counterpart, the dollar gets stronger.

The level risk premium Λ_t represents the infinite sum of the expected excess return on foreign assets for all periods in the future. While typically the international finance literature uses the term "risk premium" to refer to excess returns, here we follow the work of Maurice Obstfeld and Kenneth Rogoff (2003) to refer to the effect of these risk premiums on the level of the real exchange rate. Holding real interest rates constant, a larger λ_t implies a higher excess return on the foreign investment. Holding R_t constant, a larger Λ_t implies the dollar is stronger in real terms.

While we call Λ_t a risk premium, we do not necessarily endorse the position that the excess return represents a reward for bearing risk. Indeed, λ_t might instead (or as well) capture one or more of the following: (a) A liquidity premium, if foreign assets were less liquid than U.S.

assets. (b) A deviation of the market's expectation from the statistical expectation (Jeffrey A. Frankel and Kenneth A. Froot (1987)). (c) Sluggish portfolio adjustment (Philippe Bacchetta and Eric van Wincoop (forthcoming)). (d) Heterogeneous information across market participants (Bacchetta and van Wincoop (2006)). In sum, while we call λ_t a risk premium and Λ_t a level risk premium in order to have some convenient label, we do not take a stand on the economic forces that lead to non-zero values of Λ_t : λ_t is defined by equation (1) irrespective of economic interpretation.

Our goal in this paper is to estimate R_t and compute $\Lambda_t = -q_t - R_t$ for six currency pairs noted below, and then to examine their movements.

1. Measurement

The monthly currency pairs we study are the real value of the dollar relative to the euro (as represented by an aggregate of the real value of three major eurozone countries: Germany, France, and Italy), the U.K. pound, the Swiss franc, the Canadian dollar, and the Japanese yen. We also consider the dollar exchange rate against an aggregate of these currencies.[1] Our nominal exchange rates are from the Federal Reserve database, for the last day of the month. We use 30-day Eurocurrency deposit rates, end of month, as our measure of the nominal interest rate, from Datastream. Inflation rates are constructed from CPI price indexes available from the OECD. Our VAR analysis also includes monthly unemployment data, from the OECD, and monthly commodity price inflation, calculated from the non-fuel commodity dollar price index available from International Finance Statistics. We multiply all series by 100.

Estimation of R_t requires estimates of $E_t\left(r^{US}_{t+j} - r^{*}_{t+j}\right) \equiv E_t\left((i^{US}_{t+j} - \pi^{US}_{t+j+1} - (i^{*}_{t+j} - \pi^{*}_{t+j+1}\right)$ for all $j \geq 0$. We estimate a five-variable VAR for the U.S. relative to each country (or country aggregate in the case of the eurozone countries and the seven-country aggregate) that includes the U.S. relative to foreign values of the nominal interest rate, the inflation rate, the real exchange rate, and the unemployment rate, as well as the dollar commodity inflation rate. Our VAR includes three lags of each variable.

We include the relative unemployment rates in the two countries as a simple measure of the relative output gaps. This variable may be helpful in forecasting future inflation, because a Phillips curve relates inflation rates to the output gap. In addition, interest rates set by monetary policymakers might respond to the unemployment rate. For a similar reason, we include commodity inflation. Inflation in the dollar price of commodities might help forecast relative inflation especially because commodity prices are forward-looking and respond to inflation news. We do not, however, take a structural stand on what forces drive our measures of the real interest rates, though it is not implausible to surmise that monetary policy – either anticipated or unanticipated – has some substantial influence on those rates.

The estimation period is October 1979 to July 2007. The starting date is chosen because many commentators have claimed that the Volcker era represented a break in U.S. monetary policy, so that there may be a break point in the data-generating process for nominal interest rates and inflation. We chose to base the coefficient estimates on data only through July 2007 because we are concerned that the dramatic fluctuations in the economic variables in the last two years may have an undue influence on our coefficient estimates. With the coefficient estimates in hand, we use standard present value VAR calculations to get estimates of R_t monthly through October 2009 (using the usual, rather than out of sample, formulas even for data after July 2007). We then compute $\Lambda_t = -q_t - R_t$. (Here and in the remainder of the paper, we ignore sample means.)

Table 1 reports some statistical properties of these estimated variables. For each country, the diagonal elements are the standard deviations of q_t, R_t and Λ_t and the off-diagonal elements are the correlations.

Table 1

Estimated Standard Deviations and Correlations of q_t, R_t and Λ_t

Agg.	q	R	Λ	Eurozone	q	R	Λ
q	13.36	-0.226	-0.975	q	15.85	-0.521	-0.986
R		2.97	0.003	R		2.84	0.371
Λ			13.01	Λ			14.57

Canada	q	R	Λ	Japan	q	R	Λ
q	11.25	-0.862	-0.966	q	19.13	0.153	-0.995
R		4.08	0.702	R		2.00	-0.252
Λ			8.01	Λ			19.53

Switz.	q	R	Λ	U.K.	q	R	Λ
q	16.05	-0.302	-0.921	q	12.22	0.346	-0.919
R		6.30	-0.094	R		6.63	-0.688
Λ			15.37	Λ			15.80

Notes: Diagonal elements are standard deviations, off-diagonal elements are correlations. Expectations are calculated from VAR coefficients estimated 1979:10-2007:7. Correlations and standard deviations are based on estimates of R_t and Λ_t for 1979:10-2009:10. The "agg." is an aggregate defined in footnote 1.

From Table 1, we note that Λ_t is more volatile than R_t. In two cases, Japan and the U.K., in which Λ_t and R_t are negatively correlated, we find that Λ_t is even more volatile than the real exchange rate. In all cases, Λ_t and q_t are highly negatively correlated, with all of the correlation coefficients being larger than 0.9 in absolute value.

The fact that the standard deviation of Λ_t is almost as large as the standard deviation of q_t, and the fact that Λ_t and q_t are highly negatively correlated might tempt one to conclude that we can attribute almost all movements in q_t to movements in the level risk premium. But this is misleading for two reasons. The first—which we ignore in the rest of the discussion—is that Λ_t impounds any discrepancy between our VAR estimate of R_t and the analogue computed using market expectations. The second is that Table 1 does not represent an orthogonal decomposition of the volatility of the real exchange rate. In many cases, R_t and Λ_t are correlated. In some cases (Canada and the eurozone) the correlation is positive, while for the U.K. it is strongly negative. The correlation between the long-term real interest rate and the real exchange rate is negative for most of the currency pairs (the exceptions being the U.K. and, weakly, Japan.) Coincidentally, for the weighted average real exchange rate, R_t and Λ_t are nearly uncorrelated. We can see in this case that the level risk premium accounts for a very large share of the variance of q_t (approximately 94.6 percent.)

The overall conclusion is that while there is a fairly robust negative correlation between the long-run real interest rate differential and the real value of the dollar, the correlation is strongest only when the long-run real interest differential is highly positively correlated with the level risk premium. That is, in cases where the real exchange rate seems to vary strongly inversely with the long-run real interest rate, we cannot separate out a real-interest rate effect from a risk premium effect. In all cases, as we have noted, there is a strong correlation between the level risk premium and the real exchange rate.

The real exchange rate is negatively correlated with R_t for four of the six currencies we report. When we estimate R_t for the French, German, and Italian currencies separately, we also find a negative correlation. This is an interesting finding because it is supportive of the literature that links real exchange rates to real interest differentials, and perhaps surprising in light of the empirical literature on uncovered interest parity.

The literature on real exchange rates from the 1970s and 1980s emphasized the role of real interest differentials in driving real exchange rates. Jeffrey A. Frankel (1979) showed how an increase in a country's short-term real interest rate should lead to a real appreciation of the currency. Frankel provided some evidence in support of his structural model by examining the behavior of the dollar/German mark rate. Nelson C. Mark (2009) is an example of a recent empirical study that links the level of real exchange rates to the real interest differential.

But our findings might be surprising if one considers the well-known uncovered interest parity puzzle and many of the attempts to account for the finding theoretically. When expressed in real terms (using real interest rates and real exchange rates), the puzzling empirical finding is that $q_{t+1} - q_t$ and $r_t^{US} - r_t^*$ are negatively correlated. Since, $E_t q_{t+1} - q_t$ should equal $r_t^{US} - r_t^*$ under risk-neutral uncovered interest parity, the negative correlation implies that the risk premium, λ_t is negatively correlated with the interest differential. One might be tempted to conclude (as some studies imply), that the risk premium can be described by:

(3) $$\lambda_t = -\gamma\left(r_t^{US} - r_t^*\right) + \varepsilon_t ,$$

where γ is a constant ($\gamma > 1$ allows a negative correlation between $E_t q_{t+1} - q_t$ and $r_t^{US} - r_t^*$), and ε_t is a mean-zero random error uncorrelated with $r_t^{US} - r_t^*$. If this were correct, then equation (1) could be expressed as

(4) $$E_t q_{t+1} - q_t = (1-\gamma)\left(r_t^{US} - r_t^*\right) + \varepsilon_t .$$

Solving this equation forward implies:

(5) $$q_t = (\gamma - 1)R_t - \varepsilon_t + \bar{q} .$$

Equation (5) implies a positive relationship between q_t and R_t, but our estimates tend to find the opposite relationship.

In most cases, we find a relationship between real exchange rates and real interest rates that is consistent with some monetary models of real exchange rates, but perhaps at odds with many risk-based explanations of the interest-parity puzzle. Charles Engel (2010) explores this and related findings and their implications for models of the foreign exchange risk premium.

2. The Crisis

We now turn to examination of the U.S. real exchange rate during the global financial crisis and in its aftermath (July 2007-October 2009). We focus on trends that persisted for at least a few months. We acknowledge that even a few months may be too short a period to apply a model like ours; a negative correlation between *q* and *R*, for example, might not be manifest in short time periods. With that bit of caution, we plunge in.

Figure 1 – Plots of q_t, R_t and Λ_t for the Aggregate of All Countries

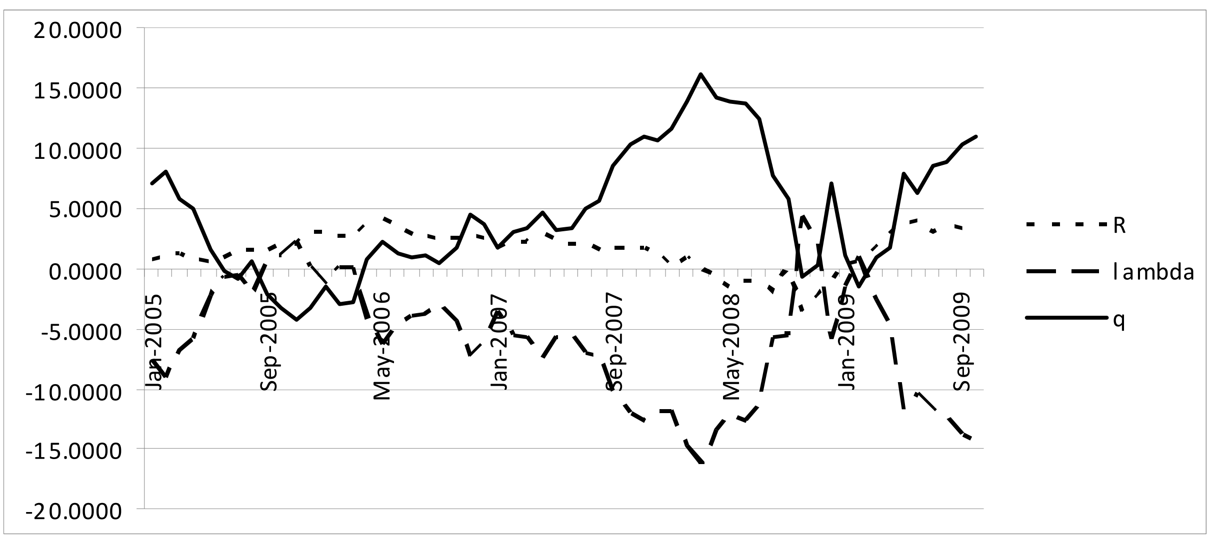

Figure 1 plots fitted values for q_t, R_t and Λ_t for the aggregate of the six currencies. We omit the graphs for the other currencies in order to save space. Their behavior generally mimics that of the six-currency aggregate.[2]

First, we discuss the behavior of the real exchange rate itself. We refer to Figure 1, and identify three distinct sub-periods during the crisis.

July 2007-March 2008: Dollar depreciation

While the dollar generally depreciated in real terms from November 2005, there is a noticeable acceleration of the depreciation of the dollar beginning in July 2007 through March 2008. Many commentators select July or August 2007 as the commencement of the financial crisis. In late July, Bear Stearns announced that two hedge funds with subprime exposure had little value. In August, markets were shaken up by the announcement of BNP Paribas that it was suspending three funds invested in subprime mortgage debt, and Countrywide Financial, the largest mortgage lender in the U.S. announced high levels of mortgage delinquencies. There was a coordinated injection of liquidity by the Fed, the ECB and the Bank of Japan on August 10th, and the Fed lowered the discount rate by 50 basis points on August 17th.

March 2008 – March 2009: Dollar appreciation

The dollar appreciated during this period following the collapse of Bear Stearns in March 2008, except for a brief sharp depreciation in December 2008 that was reversed the next month. The appreciation of the dollar, if anything, accelerated through the crucial months of September and October 2008. (Recall Lehmann Brothers failed on September 15th, and the Federal Reserve began its extraordinary bailout of AIG on September 17th.)

March 2009 – September 2009: Dollar depreciation

The dollar depreciated in real terms during this period. This period coincides with the abatement of the worldwide crisis.

It is difficult to tell a simply story tying the movements in the real exchange rate q_t to the long-run real interest rate, R_t. Recall from equation (2) that $q_t = -R_t - \Lambda_t + \bar{q}$, so the sum of the

R_t and Λ_t is the negative of the real exchange rate (up to a constant term.) Figure 1 shows that the U.S. real interest rate began increasing relative to its partners in October 2008, so that perhaps some of the real appreciation of the dollar in late 2008 can be attributed to a real interest rate effect. However, there are two reasons not to put too much weight on this observation. First, according to this measure, the relative real interest rate increase continued through July 2009, a period over which the dollar began to depreciate substantially. In fact, before October 2008 there is not a close (negative) correspondence between the real interest differential and the real exchange rate either. Second, our estimates of this real interest differential during 2008 are sensitive to the sample period over which the VAR is estimated. We tried estimating the VAR beginning in January 1984, since the change in monetary policy regime initiated in 1979 may have been phased in gradually. When the parameters are estimated over this shorter sample, our R_t series shows a decline over all of 2008. Of course, over short samples the co-movements between q_t and our estimate of R_t might not accurately reflect the true data generating process.

It is, however, possible to tell a story about the risk premium term Λ_t driving movements in the real exchange rate, one that involves financial markets. The real dollar depreciation from approximately late July 2007 until March 2008 is reflected in a decline in Λ_t, or an increase in the risk premium on dollar assets. It is notable that the risk premium on the dollar increased during the early period of the crisis. It appears that the markets initially treated the crisis as an American problem that raised the riskiness of U.S. assets. The dollar depreciated in real terms against all the currencies from July 2007 until March 2008, with the notable exception of the pound. During this time, the dollar did initially depreciate against the pound, but subsequently began to appreciate in mid-September 2007. That coincides with the collapse of Northern Rock, the U.K.'s fifth largest mortgage lender.

But then, remarkably, the dollar began to appreciate strongly in real terms between March 2008 and March 2009. We offer two interpretations. One is that the U.S. and U.K. financial crisis morphed into a global financial crisis with the failure of the major investment banks. The dollar was now seen as a “safe haven”, and so there was an increase in Λ_t. Alternatively, Λ_t does not represent a risk premium on foreign assets, but instead a liquidity premium. Financial institutions, in particular, were reluctant to sell any dollar denominated assets and were trying to shore up their balance sheets by acquiring safe dollar assets such as U.S. Treasury securities. Interest-bearing securities denominated in other currencies were not considered to be as useful for this purpose, so their expected yield had to increase to sell on the market.

The real exchange rate is a useful indicator of the market’s perception of relative risk. A case can be made that it conveys the message that the markets perceived the subprime crisis initially as a U.S. crisis, and then a U.K. crisis. It was only in early 2008 that the markets began to perceive a global crisis, at which time the dollar became a safe haven. As matters worsened in September 2008, the dollar assets continued to be considered safe. We believe, also, that the changes in the exchange rates over this period present a challenge for economic models of the exchange rate. It is apparent that the models need to incorporate some measure of financial risks and liquidity in order to capture the broad movements of the exchange rate.

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[1] The weights in the aggregate of the seven exchange rates as well as for the euro aggregate are determined by relative GDP levels.

[2] The real dollar/yen rate behaved differently than the aggregate real dollar rate in the critical period of September 2008 to March 2009. The yen appreciated relative to the dollar during this period while the dollar appreciated against other currencies at that time.