E C O N O M I C S B U L L E T I N

Is the real dollar rate highly volatile?

Stefan Norrbin
Florida State University

Onsurang Pipatchaipoom
Samford University

Abstract

This note updates the real exchange rate behavior observed by Lothian (1998). Specifically, we investigate the volatility of the U.S. dollar relative to other major currencies using updated data, and reestimate the real exchange rate using alternative currency baskets. The results confirm Lothian's suggestion that the dollar is highly volatile. However, other major currencies also have high volatility. In fact, the DM is surprisingly calm relative to most major currencies. Thus the use of the DM as a numeraire would be preferred to any other major currency.

Citation: Norrbin, Stefan and Onsurang Pipatchaipoom, (2007) "Is the real dollar rate highly volatile?." *Economics Bulletin*, Vol. 6, No. 2 pp. 1-15
Submitted: February 1, 2007. **Accepted:** February 10, 2007.
URL: http://economicsbulletin.vanderbilt.edu/2007/volume6/EB-07F30004A.pdf

1 Introduction

The real exchange rate of the U.S. dollar is found to be highly volatile in an article by Lothian (1998). Specifically, Lothian pointed out that the U.S. dollar real exchange rate experienced a sharp period of appreciation in the early 1980's resulting in a much higher volatility relative to the Deutsche Mark (DM). This finding has important implications for research in International Finance. International economists have to find convincing explanations for why the U.S. dollar had such a major adjustment in the 1980's, and why other currencies have not experienced similar movements. In addition, empirical tests that use the dollar as a numeraire will be affected by such a substantial adjustment in the data. For example, purchasing power parity (PPP) tests would be affected. Such concerns have been noted by, for example, Koedijk et al. (2004), and Papell and Theodoridis (2001) who find stronger results in favor of PPP among European countries as compared to non-European countries.

In this paper, we examine whether the "stylized facts" of real exchange rate behavior introduced by Lothian (1998) maintain their validity when more data are added. Specifically, we investigate five different issues surrounding the earlier results. We first investigate if the excessive behavior of the dollar in the 1980's was an isolated event. If this is the case, once the problematic event of the dollar appreciation in the 1980's passed, the dollar would adjust back to its equilibrium state. Secondly, we examine if the dollar behavior is excessive relative to other major floating currencies. Finding one currency that is less volatile than the U.S. dollar, as in Lothian (1998), does not necessarily mean that the U.S. dollar is particulary volatile. To support such a statement, one needs to examine the relative volatilities of the U.S. dollar and other major currencies. The third hypothesis examined in this paper concerns the equal-weighting of the exchange rate index in Lothian's investigation. Most economists are used to apply a trade-weighted exchange rate index. Thus we compare the volatilities of the major currencies using a trade-weighted index to investigate if this adjustment alters the conclusion. The final hypothesis tested in this paper concerns the choice of currencies used to construct the exchange rate index. Most of the 22 countries used in the currency basket are or have been in some form of exchange rate coordination with the DM. Therefore, comparing the DM may be artificially stable. We investigate this concern by recomputing the real exchange rates using only countries that did not participate in exchange rate agreements during the time period. The following section presents our data and evidence regarding the above five hypotheses, and in the final section we conclude.

2 Data and Empirical Evidence

In this section, we extend Lothian's data for the United States and 22 other OECD countries with one additional decade of data; that is, our data set includes data for the 1974 through 2004 period. To test the above hypotheses, the real exchange rates are

constructed for the U.S. dollar, DM, Canadian dollar, Japanese yen, Swiss franc, and British pound.[1] Following Lothian we obtain annual nominal exchange rates and consumer price indices from the International Financial Statistics database with 1980 as a base year.[2] The real exchange rate is constructed as:

$$q_{i,t} = \frac{1}{N}[\sum_{j=1}^{N}(E_{j,t} - P_{j,t} + P_{i,t})], \tag{1}$$

where q_i is the average log level of the real exchange rates for country i, E_j is the nominal foreign currency value of the domestic currency, P_j is the foreign consumer price index and P_i is the domestic consumer price index. N represents the total number of countries included in the basket of currencies, which is 22 in most cases, except for the non-ERM basket where fewer countries are used.

Table 1 shows the empirical results of the log of the real exchange rate volatility. The results for the U.S. dollar and DM real exchange rates for the period of 1974-1994 confirm Lothian's finding that the 1980's had a substantial increase in the dollar value for the 1980-1985 with a subsequent depreciation. However, once we lengthen the sample period, the stability of the U.S. real exchange rate is interrupted again by the second episode of a dollar appreciation and the subsequent depreciation in 1996-2004. The means and standard deviations of the log U.S. dollar rate in various subperiods, as reported in Table 1, support the conclusion that the two episodes are responsible for most of the variation in the U.S. dollar. The second "hump" in the U.S. dollar real exchange rate has almost the same standard deviation as the first one and with a slightly lower mean of 0.277 and 0.175 for the first and second episodes of large appreciation, respectively. Thus, Lothian's suggestion that the U.S. dollar behavior is exceptional in the 1980's is not supported by the results. Instead, the 1980's appears to be *one* period of substantial volatility with almost the same behavior occurring in the 1990's.

Examining the volatility of four other major currencies for the same period, in Table 1, one can see that the U.S. dollar experiences a high volatility in comparison with most other currencies. However, the Canadian dollar has a similar overvaluation period in the 1980's, but not in the 1990's. Furthermore, the Japanese yen has several periods of small overvaluation periods during the three decades resulting in the highest volatility of all the currencies. In contrast, the Swiss franc appears to be very stable and the British pound is relatively stable, with a pattern that is reminiscent of the U.S dollar pattern, but much less pronounced.

[1] See Lothian (1998) for the method of constructing the real exchange rate index and the list of 22 OECD countries. We chose not to add recent country additions to the OECD so that our results follow Lothian as closely as possible.

[2] The price indexes and spot exchange rates are series RF.ZF for the exchange rate and 64 for the consumer prices. The nominal exchange rate for the German DM is extended to 2004 by using the implicit value based on the Euro.

Examining the movement over time in Figure 1, it is evident that some currencies trend over time. This would be consistent with Balassa (1964) and Samuelson (1964) type effect, arguing that real productivity factors affecting the tradeable and nontradeable sectors differently may cause the real exchange rate to revert to a new equilibrium. To make sure that we are not including such a mean shift in the volatility calculation, we also present trend adjusted series in Table 2.

In general, the results after detrending lead to similar conclusions to the earlier ones. The detrended standard deviations in Table 2 also support Lothian's assertion that the U.S. dollar is a highly volatile currency. In fact, the U.S. dollar is the most variable among the major currencies. The U.S. dollar real exchange rate has more than twice as large standard deviation as compared to the DM rate. The Japanese yen real exchange rate ranks second in terms of volatility with a standard deviation of 0.126, followed closely by the Canadian dollar. In contrast, among the detrended real exchange rates of the six currencies, the DM and Swiss franc are the least volatile series. Interestingly, both have very similar volatility although they have never been linked historically.

The equal weighting of all the 22 OECD currencies, as used by Lothian to create the real exchange rate index, may yield different results from adjusting the index for the amount of trade between the country and its trading partners. In Table 2 we show the results of the trade-weighted real exchange rate index, using weights for each country reflecting how important the trade partner is.[3] The index calculation thus becomes:

$$q_{i,t} = \sum_{j=1}^{N} w_{ij}(E_{j,t} - P_{j,t} + P_{i,t}), \tag{2}$$

where w_{ij} represents the share of imports plus exports between country i and j as a fraction of total trade by country i to all countries in the basket. The results are similar to the equal weighted results in that the U.S. dollar is highly volatile. The U.S. volatility remains about twice as high as the DM. However, the Japanese yen is substantially above the U.S. dollar volatility, even after detrending. In addition the Swiss Franc volatility increases substantially to where it is very close to the U.S. volatility. Thus, the trade-weighting does not change the conclusion that the U.S. dollar is highly volatile relative to the DM, but the DM appears surprisingly stable relative to the other major currencies. Therefore, there is some evidence that the U.S. dollar is not very unstable relative to other currencies, except the DM.

Since the stability of the DM real rate may be a result of exchange rate ties with other countries, we also consider the U.S. dollar and the DM real exchange rate indices including only eight other OECD countries that were not the members of the European

[3]The effective real exchange rates are constructed using the BIS weighting matrix for broad indices based on 1993-1995 trade, see http://www.bis.org/statistics/eer/index.htm and Turner and Van't dack (1993) for further details of the trade weight construction. The trade weights are adjusted according to our 22-country sample.

Monetary System's exchange rate mechanism (ERM) or tied to Germany in the European Monetary Union.[4] In Table 2 we report the real exchange rate indices for the major currencies using the basket of non-ERM. Examining the real exchange rates of Germany and the U.S., we find similar results to the full OECD results, namely that the U.S. dollar is more volatile than the DM. As expected, the volatility of the DM increases, especially in the early eighties and early 2000's, but not enough to close the gap with the U.S. volatility.

3 Summary and Conclusion

This paper updates the empirical facts about the real exchange rate movements in the post-Bretton Woods period. The results indicate that the U.S. dollar has had two highly volatile periods, creating two "humps" in the value. This implies that the theories that Lothian (1998) argued should explain the overvaluation period of the dollar in the 1980's should also explain the overvaluation period in the 1990's. The updated data also confirms Lothian's argument that the dollar is highly volatile even when compared to other major currencies in the world. Furthermore, the U.S. dollar remains more volatile even when a more representative currency basket is chosen where the currencies are not aligned with either the DM or the U.S. dollar. The DM volatility increases, but not enough to approach the volatility of the U.S. dollar. Thus, the results confirm that the U.S. dollar is volatile, but not exceptionally relative to other major currencies. Instead the DM stands out as an exceptionally stable currency. Therefore, the question that economists might investigate is not why the U.S. dollar is unstable, but why the DM is so stable relative to other major currencies.

The findings lead to two conclusions for the academic economist. Data sources that are created to be comparable using the U.S. dollar will be too volatile and might not reflect the true movements over time. Furthermore, empirical tests of PPP might be affected by the choice of numeraire currency. The above results indicate that the choice of a numeraire country is important for the test results. Examining any country's real exchange rate movements against the U.S. dollar would be more likely to lead to a conclusion that the real exchange rate wanders around and statistically appear to be an integrated process. In discussing the choice of numeraire countries, the prior literature has focused on the fact that two neighboring countries would have lower transactions costs than two countries geographically far apart. However, the above results indicate that the U.S. real exchange rate movements are substantially more volatile and hence may result in even less of a probability that PPP would hold if the U.S. is used as the numeraire country. Instead, the DM should be used as a numeraire even for countries

[4]These eight countries we label non-ERM countries. Specifically they are: Australia, Canada, Iceland, Japan, New Zealand, Norway, Switzerland, and Turkey. Note that the index is created using nine countries for all the currencies except the British Pound, where only eight other countries are used.

that are geographically far from Germany, due to the stability of the real exchange rate with respect to most OECD currencies.

References

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Table 1: Summary statistics for 22-country average real exchange rates

	USD	DM	CAD	JPY	SWF	UKP
Lothian's Sample:						
1974-1994						
Mean	0.125	-0.045	0.179	0.215	0.032	-0.140
S.D.	0.137	0.057	0.123	0.195	0.077	0.096
Extended Sample:						
1974-2004						
Mean	0.141	-0.045	0.124	0.283	0.065	-0.101
S.D.	0.135	0.054	0.135	0.199	0.083	0.113
Subperiods:						
1974-1980						
Mean	0.047	0.011	0.158	0.017	-0.019	-0.222
S.D.	0.056	0.021	0.131	0.100	0.083	0.110
1981-1987						
Mean	0.277	-0.087	0.261	0.238	0.032	-0.080
S.D.	0.130	0.039	0.125	0.122	0.060	0.068
1988-1994						
Mean	0.051	-0.057	0.118	0.389	0.083	-0.118
S.D.	0.049	0.055	0.068	0.140	0.056	0.034
1995-2004						
Mean	0.175	-0.047	0.007	0.427	0.134	-0.017
S.D.	0.129	0.050	0.069	0.120	0.046	0.105

The second through seventh columns represent averages of log levels of real exchange rate indexes denominated in the US dollar, Deutsche mark, Canadian dollar, Japanese yen, Swiss franc, and British pound, respectively. Underlying data are indexes with 1980 as the base year.

Table 2: Summary statistics for 22-country average real exchange rates: trade-weighted index and non-ERM country basket

	USD	DM	CAD	JPY	SWF	UKP
			Equal-weighted index			
Mean	0.141	-0.045	0.124	0.283	0.065	-0.101
S.D.	0.135	0.054	0.135	0.199	0.083	0.113
Detrended S.D.	0.133	0.053	0.109	0.126	0.058	0.087
			Trade-weighted index			
Mean	-0.013	-0.048	-0.020	0.178	-0.013	-0.217
S.D.	0.102	0.063	0.132	0.201	0.089	0.098
Detrended S.D.	0.102	0.054	0.074	0.151	0.090	0.092
			Non-ERM country index			
Mean	0.103	-0.095	0.085	0.254	0.022	-0.138
S.D.	0.123	0.074	0.120	0.220	0.107	0.115
Detrended S.D.	0.118	0.074	0.097	0.131	0.075	0.082

The sample ranges from 1974 to 2004. The second through seventh columns represent averages of log levels of the real exchange rate indexes denominated in the US dollar, Deutsche mark, Canadian dollar, Japanese yen, Swiss franc, and British pound, respectively. Detrended S.D. represents the standard deviations of the detrended average log levels. Underlying data are indexes with 1980 as the base year. The trade-weighted real exchange rate indices are constructed by using the Bank of International Settlements (BIS) weighting matrix for broad indices based on 1993-1995 trade. The non-ERM country real exchange rate indexes are based on averages of log real exchange rates of Australia, Canada, Iceland, Japan, New Zealand, Norway, Switzerland, and Turkey denominated in major currencies.

Figure 1: Real exchange rate indexes: 22-country averages