Discussion of Charles Engel and Feng Zhu's paper

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1. Introduction

This is a creative and thought-provoking paper. In many ways, it covers familiar ground for students of open economy macroeconomics, but the contribution of the paper is to uncover some surprising and novel empirical findings within this terrain. What the paper does is to explore a series of exchange rate "puzzles" that have been widely recognised and studied in the literature, but it then asks whether these puzzles appear equally perplexing when there is no nominal exchange rate movement; ie under pegged exchange rate regimes. After all, if money was completely neutral and monetary policy irrelevant, we should see no difference in the behaviour of goods and assets prices between fixed and flexible regimes.

Of course, at least since Mussa's celebrated article (1986), it is well known that real exchange rates are much more volatile under a flexible relative to a fixed exchange rate regime. This suggests the presence of price stickiness in domestic currencies. There has been a huge follow-up literature on this question. Baxter and Stockman (1989) were the first to point out that sticky prices alone may not solve the puzzle, since when we compare fixed relative to floating regimes along other dimensions, such as output or consumption volatility, we find little difference between the two policy regimes. Flood and Rose (1995) and Jeanne and Rose (2003) pursue the mystery further by noting that excess volatility of real exchange rates seems to simply appear under floating exchange rates, without any clear fundamental drivers. A parallel literature, originated by Engel and Rogers (1996), and Engel (1999), noted that real exchange rate changes do not lead to large changes in internal relative prices. Much or most real exchange rate movement is associated with deviations in prices of the same goods across borders. The more recent literature has assembled these ideas into a "meta-puzzle" under the term "exchange rate disconnect", an expression first used in Obstfeld and Rogo (2001) (for a recent treatment, see Itskhoki and Mukhin (2016)).

What does this paper do? Essentially, it looks at the Mussa puzzle (or more generally, the exchange rate disconnect puzzle) in reverse. It asks whether real exchange rates without nominal exchange rates display a series of puzzles that have been outlined in the recent literature. The answer is ambiguous. In some cases, we can clearly establish that the anomalies in the data are due to flexible exchange rates, and do not appear under exchange rate pegs. In other cases, the results do not differ greatly between fixed and flexible exchange rates.

Aside from the details of the results for different cases, I see this paper as asking a really important question, and one that is often overlooked in the international macro literature. That is, do exchange rate economics need to be more cognisant of the nominal exchange rate? The clear answer from the paper is yes.

My comments below are organised roughly along the same lines as the paper. But one general comment I have concerns the interpretation. What do the authors want to emphasise as the main "takeaway"? One perspective is the question of

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whether exchange rate puzzles endure under fixed exchange rates. In this vein, one would take the message of the paper to say that, for many of the key anomalies found in the data, we should be looking more closely at the determinants of nominal exchange rates. But along different lines, one could see the paper as an attempt at a more insightful structural modelling of real exchange rates, untainted by volatility in nominal exchange rates. Both perspectives are interesting and potentially fruitful lines of inquiry. But they take us in different directions.[2]

The paper is long and comprehensive. It explores the whole range of anomalies that have been found in the exchange rate literature –the excess volatility of exchange rates, the uncovered interest parity puzzle, the exchange rate disconnect puzzle, the PPP puzzle, and the consumption correlation puzzle. My comments will mostly concern the excess volatility, exchange rate disconnect, and the PPP puzzle.

2. Detailed comments

2.1 Excess volatility

The first main result of the paper is that excess volatility in real exchange rates is particularly an attribute of floating exchange rate regimes. Of course this idea in itself is not new, but the paper provides a fresh perspective by deriving a various bound test of real exchange rate determination, based on the assumption that real exchange rates should be driven by the relative price of non-traded goods to traded goods. I am quite convinced by these results. They mirror previous work by Engel and others, although the particular test performed is different. Here I wish to give a theoretical interpretation of the results, and ask whether conventional open economy models can explain the different results under fixed and flexible exchange rates.

First, note that, following the decomposition in the paper, we can define the real exchange rate in logs as the sum of the nominal exchange rate and relative CPIs

$$q = s + p^* - p$$

which in turn, following the decomposition of Engel (1999) gives

$$q = p_T^* + s - p_T + \alpha_N \left(p_N^* - p_T^* - \left(p_N - p_T \right) \right)$$

This says that the real exchange rate is the sum of the relative price of traded goods and the relative price of non-traded to traded goods across countries, weighted by the (assumed equal) share of non-traded goods in the CPI.

But tradable goods usually contain a non-traded component, (for instance distribution services may require non-traded goods as inputs). Assume the share of the fully traded good (which designated with a hat) is κ. Then we can write the traded good decomposition as

$$\begin{aligned} p_T^* &= \kappa \hat{p}_T^* + (1-\kappa) p_N^* \\ &= \hat{p}_T^* + (1-\kappa)\left(p_N^* - \hat{p}_T^* \right) \\ &= \hat{p}_T^* + \frac{(1-\kappa)}{\kappa}\left(p_N^* - \hat{p}_T^* \right) \end{aligned}$$

[2] The second approach motivates the paper by Berka, Devereux and Engel (2017).

Putting all this together, for the home and foreign countries, gives the real exchange rate

$$q = \hat{p}_T^* + s - \hat{p}_T + \left[\frac{(1-\kappa)}{\kappa} + \alpha_N\right]\left(p_N^* - p_T^* - (p_N - p_T)\right)$$
$$= \Delta + \left[\frac{(1-\kappa)}{\kappa} + \alpha_N\right]\Gamma$$

where Δ and Γ are implicitly defined.

The real exchange rate is decomposed into two components; the first due to the deviation from the law of one price in traded goods, the other due to movements in the internal relative price of traded to non-traded goods across countries. The question is how do the two terms behave under alternative exchange rate regimes? The various bounds tests in the paper focus exclusively on Γ. But in order to understand the difference between flexible and fixed exchange rate regimes from the viewpoint of a theoretical model, we also need a theory for Δ.

We can break down Δ into "pricing to market" and local currency pricing (LCP). Pricing to market is defined as a situation where firms deliberately set prices in order to exploit different conditions in different markets, for instances differences in demand elasticities in different countries could lead to markup differences. We can interpret these as differences in *expected* Δ.[3] In this case we would have $E(\Delta) \neq 0$. An alternative perspective is that Δ may fluctuate because of local currency pricing (LCP) and unexpected movements in exchange rates. Then variations in exchange rates would be coming from the term $\Delta - E(\Delta)$. Many recent New Keynesian open economy models exhibit variations in real exchange rates arising from LCP. The paper finds that volatility of Γ is systematically greater than volatility of q for fixed exchange rate countries, but significantly less than the volatility of q for flexible exchange rate countries. According to our above decomposition, this should imply that much of q in flexible regimes is driven by Δ – either by pricing to market or LCP. This is quite consistent with Engel (1999) – where in fact all of q is driven by Δ.

Now take a two-country model with productivity shocks, Calvo pricing, non-traded goods, and endogenous terms of trade, allowing for productivity shocks to traded goods. Then, I ask whether in this model we can we reproduce the variance bounds results in the data. In the model, all variation in Δ is due to LCP. I calibrate so that $\left[\frac{(1-\kappa)}{\kappa} + \alpha_N\right] = 1.5$.

Figures 1 and 2 illustrate the response to a productivity shock in the traded goods sector, under fixed and flexible exchange rates, while Table 1 reproduces the theoretical variances implied by the model. Figure 1 shows that the full response of q is attributed to Γ under the fixed exchange rate regime. By definition of the model, $\Delta = 0$ in this case. The real exchange rate appreciates in response to the productivity shock. Figure 2 shows that under a flexible exchange rate regime, the response of Γ

[3] Many papers have developed models of pricing to market. See Dornbusch (1987), and Atkeson and Burstein (2008), for instance.

is approximately the same, but now Δ falls, so we do get an "excess volatility" in the real exchange rate.

Figure 1

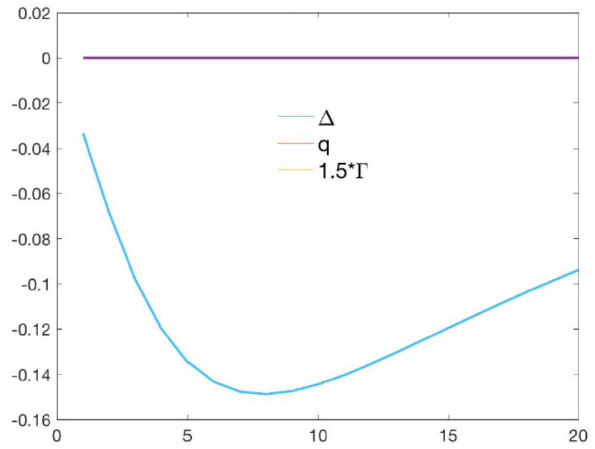


Figure 2

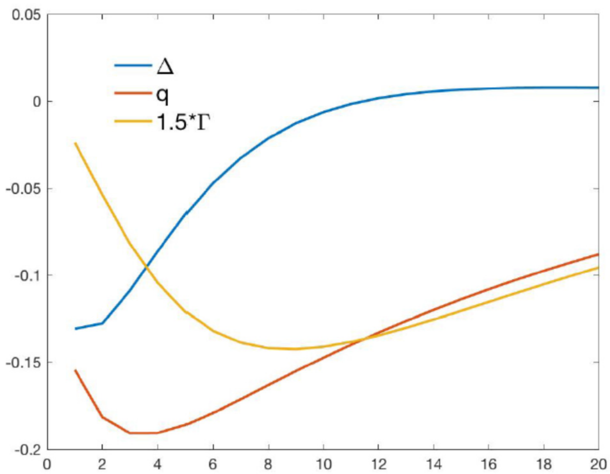
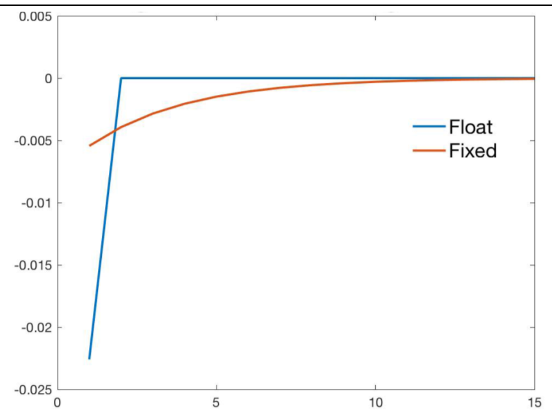


Figure 3. Real Exchange Rate



Can the model explain the variance bounds findings of the Engel and Zhu paper? Table 1 shows that the fixed exchange rate regime satisfies exactly the condition $\sigma_q = 1.5 * \sigma_\Gamma$.[4] Under flexible exchange rates, the volatility of Γ is almost the same, while now the volatility of Δ increases to about the same size as Γ. We now find that $\sigma_q = 2.9$ and $1.5\sigma_\Gamma = 2.2$, so that $\sigma_q > 1.5 * \sigma_\Gamma$. So we obtain "excess volatility", in the sense that we get the same ranking of volatilities as in the paper. But the magnitude is not large. The reason is that, while Δ is volatile, Δ, and Γ are negatively correlated (as can be seen from Figure 2). So while the results do accord with the paper's variance bounds results, they do not nearly explain the data. To see this more clearly, Table 2 reports the same objects in European data (taken from Berka et al (2017)), where we compare the within-euro zone exchange rates to the floating exchange rate European countries, using Eurostat data for prices. We see that the European data do accord with the findings of the Engel-Zhu paper, notably that the variance bounds test is

[4] I use standard deviations rather than variances for ease of interpretation.

satisfied (just) for the euro zone, but not for the floating countries. But the difference between these data and the model is that the increase in volatility of q, and Δ in comparing the euro zone with the floating regimes is much greater in the data than in the model. Thus, we are left with a puzzle in explaining excess volatility under flexible exchange rates.

Model			Table 1	Data			Table 2
Case	q	Δ	1.5Γ	Case	q	Δ	1.5Γ
Fixed	2.3	0	2.3	Fixed (EZ)	3.3	2.8	3.2
Flexible	2. 9	1.4	2.2	Flexible (EU)	7.0	6.0	4.3

2.2 Real exchange rate modelling and exchange rate disconnect

One implication one could draw from the results of the paper is that understanding and modelling real exchange rates is likely to be more successful when we focus on real exchange rates among fixed exchange rate countries. As we saw above, the theoretical variance bounds tests are generally satisfied for countries that have bilaterally fixed exchange rates. This is an intriguing hypothesis, and deserves to be followed up. The obvious framework to test is the Balassa-Samuelson model. The paper finds evidence for the real exchange rate-productivity link within a variance bounds limit test. But it is worth a deeper investigation, using structural models of the real exchange rate. Some evidence for the usefulness of the Balassa-Samuelson model for the euro zone is presented in Berka and Devereux (2013), who find a tight link between real exchange rates and real GDP per capita, both in cross section and time series, for the euro zone countries, and Berka, Devereux and Engel (2017), who find strong support for an amended version of the Balassa-Samuelson model among euro zone countries using measures of sectoral productivity (again both in time series and cross section). With the expanded availability of sectoral and micro price data for many countries, this approach is likely to be further developed over time.

2.3 The PPP puzzle

An interesting finding of the paper is that real exchange rate persistence is no less under fixed rates than under flexible exchange rates. At first glance, this seems surprising. Most reading of the literature would suggest that the driving force of both excess volatility and persistence in real exchange rates comes from movements in nominal exchange rates. But it is important to note that persistence in relative prices is quite different from excess volatility. One could make the case that, in a theoretical sense, persistence in real exchange rates should be greater under fixed exchange rates. This is because real exchange rate adjustment in fixed exchange rate areas can take place only via slow movement in relative prices across regions, while the same adjustment can in principle be achieved much more quickly within a flexible exchange rate arrangement. Figure 3 shows an example of this, comparing adjustment under fixed and flexible exchange rates with a temporary government spending shock within the model described in the previous section. We see indeed that, while the amplitude of the real exchange rate response to a government spending shock is substantially greater in a flexible exchange rate regime, the persistence is greater under a fixed exchange regime. Fixed exchange rates embody intrinsic persistence that is not necessarily a characteristic of a flexible regime.

Persistence in relative prices can also be driven by large heterogeneity in speeds of price adjustment. This point is extensively explored in Carvalho and Nechio (2011).

To see this, take two sectors 1 and 2, with two regions E and W. Say that the real exchange rates are among E and W are driven by AR(1) processes as follows.

$$q_1 = \lambda_1 q_{1,-1} + u$$
$$q_2 = \lambda_2 q_{2,-1} + u$$

Then the overall real exchange rate is defined as:

$$q = \frac{q_1 + q_2}{2}$$

Carvalho and Nechio (2011) show that the aggregate real exchange rate will be an ARMA(2,1) process, as follows

$$q = \left(\lambda_q + \lambda_2\right) q_{-1} - \lambda_1 \lambda_2 q_{-2} + u - \frac{\lambda_1 + \lambda_2}{2} u_{-1}$$

Then, persistence in the real exchange rate will be driven by the largest root (most persistent sector) of the underlying sectoral real exchange rates. Again however, this will not depend on the nominal exchange rate. Persistence within countries could be just as great as that across countries.

2.4 Consumption risk-sharing

An interesting finding of the paper is that consumption risk-sharing does not seem to be linked to the nominal exchange rate. For the most part, risk-sharing seems to be similar across countries within fixed exchange rate systems as across flexible exchange rate systems, even when one explicitly accounts for the role of real exchange rate movements in risk-sharing (ie the Backus-Smith condition). This is a surprising finding, and seems to be at variance with the results of Hadzi-Vaskov (2008), Hess and Shin (2008), and Devereux and Hnatkovska (2013). It is not clear to me what is driving the difference in results. It will be interesting to explore further the different specifications.

3. Conclusions

This paper has set out a series of interesting results on the properties of real exchange rates under fixed exchange rate regimes. One the one hand, it suggests an agenda for exploring and testing models of real exchange rates without being "contaminated" by nominal exchange rates. On the other hand, it underscores the importance of nominal exchange rates in any theoretical approach to understanding real exchange rate anomalies. In this respect it seems to accord well with an idea often associated with the BIS. That is, that monetary economies are very different from standard theoretical general equilibrium models.

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