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Exchange rate puzzles

The first four of Obstfeld and Rogoff's puzzles deal with **quantities**, but the last two deal with relative **prices** namely the real and nominal exchange rate. They address two puzzles: the purchasing power parity (PPP) puzzle and the exchange rate disconnect puzzle. Properly speaking, the first is a special case of the second. However, since their discussion of the disconnect puzzle is so nihilistic, my focus will be on the former.

A. The PPP puzzle

The issue is the very weak relationship between nominal exchange rates and national price levels.

- Recall that the **law of one price** is the hypothesis that a given "homogeneous" commodity should sell for the same price everywhere. That is, if P_{wheat} is the price of wheat in Australian dollars and P^*_{wheat} is the price of wheat in US dollars, the law of one price tells us to expect

$$P_{\text{wheat}} = \mathcal{E} P^*_{\text{wheat}}$$

  where $\mathcal{E}$ is the nominal exchange rate (i.e., the relative price of the two **currencies**: nominal exchange rates are usually written as the price of foreign currency in terms of domestic currency). If goods markers were perfectly frictionless, this relationship would be enforced by arbitrage. In reality, the law of one price dramatically fails for numerous reasons — not least of which are the existence of the kinds of trade costs that Obstfeld and Rogoff focus on.
- For some goods, the law of one price works well but for others it fails badly. Attached are some tables from Rogoff (1996, JEL) that emphasize this. The first table has the price of "Big Macs" expressed in a common currency. They are very different. Why? Because even this seemingly homogenous product contains a lot of non-traded intermediate inputs (e.g., labor costs, building and materials costs). Market-specific pricing structures are also important. The second table has prices of gold expressed in a common currency. These are very similar and the law of one price seems to work well.
- Suppose we have a fixed **basket of commodities**. The **price level** is the domestic price of that fixed basket in terms of a given numeraire. If that numeraire is domestic currency, say Australian dollars, we refer to it as a **nominal** price level.

- Now let i index a fixed basket of goods and let national price levels be

$$\begin{aligned} P &= \sum_i w_i P_i \\ P^* &= \sum_i w_i P_i^* \end{aligned}$$

with weights w_i. The PPP hypothesis comes in two forms. First, **absolute** *PPP* is the hypothesis that

$$P = \mathcal{E} P^*$$

or

$$\log(P) = \log(\mathcal{E}) + \log(P^*)$$

If so, the fixed basket of commodities costs the same everywhere. The PPP hypothesis is the macro analog for a basket of commodities to the law of one price for just a single commodity.

- For a number of practical reasons, absolute PPP is difficult to test. For example, the basket of commodities used by different countries to construct national price indices varies considerably, so we typically have weights w_i and w_i^* (for example). Moreover, national price level data come in the form of index numbers (relative to some base year) and we don't usually know whether PPP actually held in the base year itself.

- The second form is **relative** *PPP*, which is the hypothesis that

$$\frac{P_{t+1}}{P_t} = \frac{\mathcal{E}_{t+1}}{\mathcal{E}_t} \frac{P_{t+1}^*}{P_t^*}$$

or

$$\log\left(\frac{P_{t+1}}{P_t}\right) = \log\left(\frac{\mathcal{E}_{t+1}}{\mathcal{E}_t}\right) + \log\left(\frac{P_{t+1}^*}{P_t^*}\right)$$

- In either case, the PPP hypotheses suppose a very tight relationship between exchange rates and national price levels.

- The **real exchange rate** is the relative price of a fixed basket of commodities. If P and $\mathcal{E}P^*$ denote the price levels of two countries measured in a common numeraire (in this case domestic currency), then the real exchange rate may be defined as

$$\mathcal{Q} \equiv \mathcal{E}\frac{P^*}{P}$$

A real depreciation is a rise in $\mathcal{Q}$. When the real exchange rate is depreciated, it costs more to buy the same basket of goods at home. So an alternative way to state the absolute PPP hypothesis is that $\mathcal{Q} = 1$ or $\log(\mathcal{Q}) = 0$.

- We expect the PPP hypothesis to be false in the strong sense that $\log(\mathcal{Q}_t) \neq 0$ for all t. But lots of theoretical models can give rise to short-run ("transitory") real exchange rate deviations. For example, models with short-run nominal rigidities but long-run monetary neutrality will typically imply that the real exchange rate can deviate from its long-run level but that such deviations are ultimately mean reverting.
- This suggests the following fairly weak test of the PPP hypothesis. Run a time series regression of the form

$$\log(\mathcal{Q}_t) = \alpha + \eta t + \gamma \log(\mathcal{Q}_{t-1}) + \varepsilon_t$$

  where $\mathcal{Q}_t$ denotes the bilateral real exchange rate between two countries. It is often very difficult to reject hypothesis that real exchange rate has a "unit root" ($\gamma = 1$). That is, it is hard to reject idea that there is **no** mean reversion in real exchange rate data. In fact, there is a large literature that uses the PPP hypothesis as a "testing ground" for new unit root econometric procedures. Many of these papers claim success for the PPP hypothesis if they find evidence that $\gamma < 1$.
- Obstfeld and Rogoff present typical estimates from monthly data (1973-1995) for several industrialized countries. The largest persistence coefficient is $\gamma = 0.99$ (for the US/Canada real exchange rate), which implies that the half-life of a shock ε_t is 69 months or $5\frac{3}{4}$ years. The smallest persistence coefficient they report is $\gamma = 0.97$ (for Germany/Japan) which implies a half-life of 21 months or $1\frac{3}{4}$ years.
- By themselves, long half-lives are not necessarily a puzzle. It depends on what the sources of the shocks are. But it is widely agreed in the literature that most of the short-run volatility in $\log(\mathcal{Q})$ comes from volatility in the nominal exchange rate, $\log(\mathcal{E})$. And we strongly suspect that most of the volatility in $\log(\mathcal{E})$ is due to monetary/financial shocks. But if monetary/financial shocks are main reason why $\log(\mathcal{E})$ and hence $\log(\mathcal{Q})$ is volatile, what is the source of nominal rigidity that gives rise to such persistent deviations? That is, what kind of nominal rigidity can give rise to a half-life for a monetary shock of, say, $5\frac{3}{4}$ years?
- To reinforce this point, I have attached a figure from Rogoff (1996, JEL) that shows the US/Germany nominal exchange rate and relative consumption indices, i.e., $\log(\mathcal{E})$ and $\log\left(\frac{P^*}{P}\right)$.

If PPP held, these series would be the same

$$\log(\mathcal{E}) - \log\left(\frac{P^*}{P}\right) = 0$$

This is clearly not the case. Moreover, the volatility of $\log(\mathcal{E})$ is considerably larger than the volatility of $\log\left(\frac{P^*}{P}\right)$. In short:

$$\mathsf{Var}\left\{\log(\mathcal{E})\right\} \gg \mathsf{Var}\left\{\log\left(\frac{P^*}{P}\right)\right\}$$

- A couple of other points: mean reversion in the real exchange rate is not much quicker when we disaggregate consumer price indices into traded and non-traded goods. Mean reversion is still extremely slow for traded goods.
- But mean reversion is much faster if we look at **producer** price indices! On-the-dock import prices seem to adjust relatively quickly to nominal exchange rate shocks. The rate of "pass-through" from nominal exchange rate shocks to import prices is about 0.50 after one year.

B. Exchange rate disconnect

- The relationships between nominal exchange rates and other "fundamental" macro variables are extremely weak.
- This is especially surprising, because for many countries, especially small open economies, the exchange rate is most important relative price. The exchange rate affects essentially all transactions, so maybe we ought to expect it to be the **most** "connected" relative price!

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