3 Lecture 3: The determinants of the real exchange rate

Associate reading: Krugman-Obstfeld chapter 15 p. 369-373, p. 379-393

Intertemporal theory of the current account:

- what determines international trade across time (current account) and (world as a whole) the associated relative (real) price - the real interest rate (total world supply of saving equals total world supply of investment).
- Intratemporal prices assumed constant (just one good at each date).

This section: what determines intratemporal, relative (real) prices in an open economy.

3.1 Notation

- E nominal exchange rate (measured in units of home currency per foreign one; e.g. £/\$).
- P_i home price of good i (in units of home currency)
- P_i^* foreign price of good i (in units of foreign currency)
- P price of home basket of goods(e.g. CPI, PPI) (in units of home currency)
- P^* price of foreign basket of goods (e.g. CPI, PPI) (in units of foreign currency)

3.2 Definitions

- Real exchange rate

$$RER = \frac{EP^*}{P} \tag{32}$$

  - Relative price of foreign basket of goods relative to home basket. Relative cost of living in the two countries.
  - Measure of competitiveness if all goods in the two baskets are tradeables.
  - Used to predict direction (i.e. long run tendency) of appreciation/depreciation of the nominal exchange rate E.

- Real effective exchange rate:

$$EffRER = \sum_j \alpha_j RER_j \tag{33}$$

were α_j are country weights reflecting trade shares with country j.

3.3 Theories of cross-country price differences

- Law of one price (LOP).

  In the absence of trade barriers and transport costs the price of same good i measured in the same units should be the same

$$P_i = EP_i^* \tag{34}$$

- Purchasing power parity (PPP)

  1. Absolute: relative price of home and foreign basket equals 1.

$$RER = \frac{EP^*}{P} = 1 \tag{35}$$

  Note that it applies to baskets of goods not individual goods. It holds if LOP holds for each good in the basket *and provided the baskets are the same in the two countries.*

  2. Relative: relative price of home and foreign basket is constant.

$$\frac{\Delta RER}{RER} = \Delta E/E + \Delta P^*/P^* - \Delta P/P = 0.^1 \tag{36}$$

  RER is constant, but not 1. Absolute PPP implies relative PPP but not viceversa.

[1] See maths handout. Percentage change in product (ratio) equals sum (difference) of percentage changes in the factors.

3.4 PPP as a theory of the exchange rate

3.4.1 Prediction

$$\frac{\Delta E}{E} > 0 \text{ if } \frac{\Delta P}{P} > \frac{\Delta P^*}{P^*} \text{ and viceversa.}$$

How good a theory of the exchange rate?

3.4.2 Empirical evidence (summary)

- LOP does not hold very well (even for traded goods). Deviations not constant across time (price stickyness, larger in short run).
- Relative changes in national price levels not very informative about nominal exchange rate changes.
- Relative PPP does better than absolute PPP but still not a very good predictor of exchange rate changes.

3.4.3 Conceptual problems with PPP: understanding the empirical evidence

Baskets are not the same across countries. In particular certain goods are not traded at all as transport costs would be too large a fraction of their price (hair cuts, taxi rides, etc.).

Consider two goods in each country, price index is a geometric average, α share of non-tradeables in the consumption basket.

$$P = P_T^{1-\alpha} P_N^{\alpha} = P_T \left(\frac{P_N}{P_T} \right)^{\alpha} \tag{37}$$

$$P^* = (P_T^*)^{1-\alpha^*} (P_N^*)^{\alpha^*} = P_T^* \left(\frac{P_N^*}{P_T^*} \right)^{\alpha^*} \tag{38}$$

$$RER = \frac{EP^*}{P} = \frac{EP_T^*}{P_T}\frac{(P_N^*/P_T^*)^{\alpha^*}}{(P_N/P_T)^{\alpha}} \tag{39}$$

Three components:

1. relative price of tradeables $\frac{EP_T^*}{P_T}$;

2. home relative price of tradeables/nontradeables P_N/P_T;

3. foreign relative price of tradeables/nontradeables P_N^*/P_T^*.

- Only $\frac{EP_T^*}{P_T}$ is related to "competitiveness". So changes in RER are a good measure of changes in competitiveness only if the other two terms do not change much[2].
- Absolute PPP requires (sufficient though not necessary): 1) LOP for tradeables; 2) same relative prices of tradeables/nontradeables; 3) same consumption baskets ($\alpha = \alpha^*$). Highly unlikely to be met in practice.
- Relative PPP requires: 1) Constant relative price of tradeables; 2) constant relative prices of tradeables/nontradeables and 3) constant weights.

[2]This assumption is often hidden in models that use RER as a measure of competitiveness.

- Relative PPP implies that RER is constant, but says nothing about its level. Difficult to conclude whether E is above or below its PPP level. Usually one takes the PPP level to be some average of past RER.

Empirical evidence concerning relative PPP (conditions for absolute are not met):

1. Frenkel (1978) study for hyperinflation economies supports it. Not surprising, in hyperinflations movements in the aggregate price level dwarf any movement in relative prices.

2. Bic Mac index: large cross country variation.

3. Rogoff puzzle: PPP holds in the medium run, but in the SR RER is highly volatile and it reverts to PPP slowly (approx. 15% a year).

   This is a puzzle since one would expect SR fluctuations driven by monetary/financial market shocks to die out quickly (as they are due to price rigidities). The slow rate of reversion points instead towards real shocks which are thought to be low frequency. But this is difficult to reconcile with the high SR volatility.

How can we understand the empirical evidence?

Two possible causes for empirical failure: 1) failure of LOP; 2) changes in relative prices of tradeables/nontradeables

1. Studies focusing on LOP.

   - Engel (1993) and Rogers and Jenkins (1995): deviations from LOP for individual traded goods are very large in comparison to fluctuations in relative prices within a country. The former can explain 81% of the variability in RER as opposed to changes in P_N/P_T[3].
   - Engel and Rogers (1994): variability of relative price of a given good within a country depend on distance between locations. Crossing the border between US and Canada though has the same effect on variability as a 2,500 (!) miles increase in distance.

[3]Though this is not the main object of their study, it lends support to the use of RER as a measure of competitiveness.

They conclude that this is evidence of sticky prices. Problems: 1) price stickyness at 3/4 years horizon?!; 2) traded goods contain large non-traded components (e.g. Big Mac). Differences much larger across than within countries (i.e. labour is less mobile across countries).

- Imbs, Mumtaz, Ravn and Rey (2005): aggregation bias. Price differences for individual goods revert to their mean at different speeds. The *estimated* rate of convergence to the mean of the average across these is biased downward (aggregation bias). Correcting for this bias RER revert to its mean in a year on average (agaist 5 years in Rogoff). Consistent with reasonable price stickyness.

2. Changes in the relative price of tradeables/non-tradeables. We need models that can account for them. We can classify these models according to: a) supply-based (Balassa-Samuelson); demand-based driven by b) changes in wealth (Krugman); changes in government expenditure/taxes.

3.5 Explanations for changes in the tradeable/non-tradeable price

3.5.1 Supply-based: Balassa-Samuelson

The model is meant to explain why richer countries tend to have higher price levels. It assumes LOP holds for tradeables. Hence everything must be driven by different relative prices of tradeables/nontradeables.

- Two countries, two sectors (tradeables and nontradeables).
- LOP for tradeables: $EP_T^*/P_T = 1$.
- CRS technology with labour only input: $Y_T = A_T L_T$, $Y_N = A_N L_N$. The same for foreign countries with starred variables denoting foreign quantities/technologies.

- Competitive factor and product markets:

$$\frac{w_i}{P_i} = A_i, \tag{40}$$

with $i = T, N$.

- Free labour mobility across sectors (same wage): $w_T = w_N$.

This implies equal marginal value product of labour in the two sectors within each country

$$P_T A_T = P_N A_N \tag{41}$$

$$P_T^* A_T^* = P_N^* A_N^* \tag{42}$$

We can then use equations (37) and (38) to obtain

$$P = P_T \left(A_T/A_N\right)^{\alpha} \tag{43}$$

$$P^* = P_T^* \left(A_T^*/A_N^*\right)^{\alpha^*} \tag{44}$$

$$RER = \frac{EP_T^* \left(A_T^*/A_N^*\right)^{\alpha^*}}{P_T \left(A_T/A_N\right)^{\alpha}} = \frac{\left(A_T^*/A_N^*\right)^{\alpha^*}}{\left(A_T/A_N\right)^{\alpha}} \tag{45}$$

where the last step follows from LOP.

Assume, for simplicity, the consumption basket is the same in the two countries ($\alpha = \alpha^*$).

$$RER = \left(\frac{A_T^*/A_N^*}{A_T/A_N} \right)^{\alpha} \tag{46}$$

- The ratio of the foreign versus home price level is increasing in the difference in the relative productivity difference between tradeables and nontradeables in each country.
- Countries that have a higher productivity *difference* in the tradeable sector relative to others should have a higher relative cost of living.
- Intuition: suppose a small country which takes the foreign price of tradeables as given, suppose also the exchange rate is fixed.

LOP implies the home price of tradeables P_T is given. An increase in A_T increases the demand for labour in the tradeable sector and raises w_T by equation (40). Because of free labour mobility also w_N has to increase otherwise nobody would work in the nontradeables sector. If A_N is unchanged P_N has to go up to keep the real cost of labour in the nontradeable sector unchanged. Hence, P_N raises at unchanged P_T and P increases. Note that nothing would change if A_T and A_N would go up by the same amount. It is *relative* productivity in the tradeable sector that matters.

- Rich countries tend to have higher productivity, since productivity in the nontradeable sector is more stagnant they are also likely to have higher relative productivity[4]. A second prediction is that fast growing countries should see their real exchange rates appreciate.

[4]Baumol and Bowen (1966) obtain a similar result on the basis of relative productivity differential in the manufacturing versus service sector.

- Empirical evidence: between WWII and until the beginning of the 90s Japan was the fastest growing country. Its RER has appreciated sustainedly over time. On the other hand the cross-country evidence for other OECD countries is less clear cut. Note, that technology transfers across countries work against Balassa-Samuelson.

3.5.2 Demand based explanations

Note that with CRS technology and free factor mobility, the transformation frontier is linear and P_T/P_N is fully determined by the technology (on the supply side). Changes in demand affect relative quantities but not prices. The result goes through even if there are other mobile factors (e.g. capital). So, for demand to have any effect is has to be the case that either it affects the slope of the transformation frontier or the latter is not linear (this requires either the existence of some fixed factor, e.g. land, or limited factor mobility).

Government expenditure Froot and Rogoff (1991) and De Gregorio, Giovannini and Wolf (1995) find significant positive effects of government expenditure on a country's real exchange rate. Possible explanations: a) temporary effect, as factors may not be perfectly mobile in the SR or large country and effect on the world interest rate; b) permanent effect: changes in expenditure may result in changes in (distortionary) tax rates that affect the slope of the transformation frontier.

In the first case, the real exchange rate increases with increases in government if the latter increases the relative productivity in tradeables; i.e. (assuming decreasing marginal returns) if it induces a reallocation of resources towards the nontradeable sector.

Cumulative CA deficit/surplus Krugman has argued that cumulative CA deficits surpluses/deficits by affecting the net wealth of a country (net foreign assets) may affect the composition of demand between tradeables and non-tradeables. This still requires a non-linear transformation frontier and that home and foreign residents have different spending patterns.

Conclusion:

- overall the three modifications to PPP theory are insightful, but not particularly robust to supplant PPP as a theory of the long-run real exchange rate.
- Failure of LOP not only in SR (persistent price stickyness and cross country differences)
- Allowing for aggregation bias, the PPP puzzle is significantly reduced.
- In what follows, we will stick to PPP as our model of the long run real exchange rate, yet allow for a positive relationship between CA and the real exchange rate which is consistent with demand-based explanations.