11. Short Run versus Long Run Determinants of Exchange Rates

E212 Macroeconomics
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Short Run versus Medium Run Determinants of Exchange Rates

- We have seen that in the short run exchange rates are determined by uncovered interest parity, i.e. the condition that the returns on deposits in different currencies must be equal when expressed in a common currency (foreign exchange market equilibrium condition).

- We have also seen that short run interest rates are determined by the equality of the demand and the supply of money (domestic money market equilibrium condition).

- In an open economy, these two conditions must be satisfied simultaneously. We have used the simultaneous satisfaction of these conditions to see how exchange rates depend on the determinants of equilibrium in domestic money markets, i.e. the price level, real GDP and the money supply.

- We have also used the keynesian framework to see how monetary and fiscal policy can affect output, interest rates and exchange rates in the short run. A monetary expansion increases output, reduces domestic interest rates and causes a short run depreciation of the exchange rate. A fiscal expansion increases both output and interest rates, and causes an appreciation of the exchange rate.

- However, in the medium run, when prices have time to adjust, exchange rates, like interest rates, settle at their “natural” rates. Real exchange rates depend on the real factors that affect the demand and supply for a country’s goods and services, and nominal exchange rates reflect monetary differences between the country in question and the rest of the world.

- To see this, let us consider the medium and long run evolution of the dollar sterling exchange rate, as well as the exchange rate between the dollar and the, now defunct, Greek drachma.
The Long Run Evolution of the Dollar Sterling ($/£) Exchange Rate (1879-2017)
The Long Run Evolution of the Dollar Sterling ($/£) Exchange Rate

- From 1879 until 1913 the dollar sterling exchange rate was $4.86 per pound.
- After the end of World War II, in 1920, the exchange rate of sterling had fallen to $3.66.
- In 1926, when Britain returned to the gold standard, the exchange rate of sterling was restored to $4.86.
- At the end of the Second World War, in 1944, the rate had fallen to $4.04.
- In 1949 sterling was devalued to $3.69 and in 1950 further devalued to $2.80. In 1970 sterling stood at $2.4 US dollars. In 1990 it had weakened further to $1.78.
- In 2015 it was at $ 1.56 and in 2017 it stood at about $ 1.29.
The Drachma US $ Exchange Rate, 1953-2000
The Long Run Evolution of the Drachma Dollar Exchange Rate

- From 1953 to 1974 the drachma dollar exchange rate was 30 drachmas to the dollar.

- Within ten years, the value of the drachma against the dollar fell by about 5 times, so in 1985 the drachma/dollar rate reached 147.76 drachmas per dollar.

- In the next ten years the drachma had lost even more of its value, and in 1995 stood at 237 drachmas to the dollar.

- When Greece adopted the euro in 2000, the drachma rate stood at 365.6 drachmas per dollar, more than twelve times lower than in 1974.
Long Run Evolution of Exchange Rates

❖ Within a century, the value of sterling against the dollar fell by about three times.

❖ In about one quarter of the century, 25 years, the value of the drachma against the dollar fell by about a dozen times.

❖ What are the reasons for these dramatic long term developments in exchange rates?

❖ To analyse these long term trends we need to adopt a medium to long-term approach to exchange rate determination.

❖ We shall start with the law of one price, and its macroeconomic equivalent, purchasing power parity.
The “Law of One Price”

- The "law of one price" states that in competitive markets, without transport costs and barriers to trade (such as tariffs), identical goods in different countries will have the same value when their value is expressed in a common currency.

- For example, if the euro dollar exchange rate is $ 1.3, a T-shirt that costs € 30 in Paris, will cost $ 39 in New York. The euro price will be the same in New York (39 / 1.3 = 30), and in Paris.

- If this was not so, and transport costs and tariffs were zero, it would be profitable for T-shirt traders to buy T-shirts in one country and sell them in another. But this would cause their prices to be equalized.
The Law of One Price

The law of one price is in large part the assumption that one makes in the theory of international trade, that with free trade and competitive markets, product prices are equalized across countries.

\[ P_{EU}^{j} = S_{€$} \times P_{US}^{j} \]

\[ S_{€$} = \frac{P_{EU}^{j}}{P_{US}^{j}} \]
Purchasing Power Parity

The theory of purchasing power parity is the generalization of the law of one price, to all goods and services, and suggests that the exchange rate between the currencies of two countries equals the ratio of the price levels of the two countries.

The price level measures the purchasing power of money in each country, and is measured as a weighted average of the prices of various goods and services.

\[ S = \frac{P^*}{P} \]
Karl Gustav Cassel (20 October 1866 – 14 January 1945) was a Swedish economist and professor of economics at Stockholm University.

He is perhaps best known through John Maynard Keynes' book *Tract on Monetary Reform* (1923), in which he raised the idea of purchasing power parity.

Paul Einzig claimed that "Cassel was beyond doubt one of the outstanding figures in economic science during the inter-war period. His authority was second only to that of Lord Keynes, and his advice was eagerly sought on many occasions by his own Government and by foreign Governments."

He was also a founding member of the Swedish school of economics, along with Knut Wicksell and David Davidson. Cassel came to economics from mathematics. He earned an advanced degree in mathematics from Uppsala University and was made professor at Stockholm University during the late 1890s, but went to Germany before the turn of the century to study economics, publishing papers spanning just under forty years.

Apart from the rudiments of a purchasing power parity theory of exchange rates (1921), he produced an 'overconsumption' theory of the trade cycle (1918). He also worked on the German reparations problem. He was a member of many committees dealing with matters of state in Sweden.
Absolute and Relative PPP

\[ S = \frac{P^*}{P} \]

\[ s = \pi^* - \pi \]

\[ s = \frac{S_t - S_{t-1}}{S_t}, \pi^* = \frac{P_t^* - P_{t-1}^*}{P_t^*}, \pi = \frac{P_t - P_{t-1}}{P_t} \]
The Dollar Sterling Exchange Rate and the US UK Relative Price Level, 1879-2017
Drachma US $ Exchange Rate and Relative Greek US Price Level
The Monetary Approach to Exchange Rates

When one combines the theory of purchasing power parity with long run equilibrium in money markets, then one ends up with the monetary approach to the determination of exchange rates.

In the medium to the long run, price levels are determined by the ratio of the nominal money supply and real money demand in each country.

Thus, according to the monetary approach, in the medium to the long run, exchange rates are determined by the relative evolution of the money supply in the various countries, and the relative evolution of the factors affecting the demand for money, as the natural rates of real GDP and nominal interest rates.
The Monetary Approach to the Exchange Rate

\[ P = \frac{M^s}{L(Y^n, i^n)} \]

\[ P^* = \frac{M^{s*}}{L(Y^{*n}, i^{*n})} \]

\[ S = \frac{P^*}{P} \]

\[ S_{\epsilon S} = \frac{M^{s*}}{M^s} \frac{L(Y^n, i^n)}{L(Y^{*n}, i^{*n})} \]
Long Run Determinants of the Evolution of Exchange Rates

- Permanent increases in the US money supply (money growth) cause a depreciation of the dollar against foreign currencies. In contrast, permanent increases in the money supply in the rest of the world cause an appreciation of the dollar against foreign currencies.

- Permanent increases in real GDP in the US lead to increases in US money demand. Given the money supply, these lead to falls in the price level in the US and an appreciation of the dollar against foreign currencies. Conversely, increases in real GDP in the rest of the world lead to increases in money demand and falls of the price level in the rest of the world. These lead to a depreciation of the dollar.
Long Term Effects of Nominal Interest Rates on the Exchange Rate

- A final factor affecting the demand for money are changes in nominal interest rates.

- A permanent increase in nominal interest rates in the US, leads to a permanent reduction in US money demand. Given the money supply, this leads to an increase in the level of US prices, and, by the purchasing power parity condition, to a long-term depreciation of the dollar.

- On the other hand, a permanent rise in European interest rates leads to a decline in money demand in Europe. Given the money supply, this leads to an increase in the European price level and to a long-term depreciation of the euro against the dollar.
Nominal Interest Rates and the Monetary Approach

- The conclusion regarding the long term impact of a change in nominal interest rates seems to contradict the findings of the short-term approach.

- In the short term, we have seen that, through uncovered interest parity, an increase in nominal interest rates in an economy leads to a short-term appreciation, not depreciation of its currency.

- The short term appreciation of the currency whose interest rates have increased, is based on the assumption of unchanged expectations about the future evolution of the exchange rate. However, a permanent change in interest rates will lead to a change in the expectations about the future evolution of the exchange rate.
Nominal Interest Rate Differentials and Inflation Differentials

\[ i^* - i = s^e \]

where \( s^e \) is the expected future appreciation of the dollar.

Relative purchasing power parity requires that,

\[ s^e = \pi^{*e} - \pi^e \]

where \( \pi^e \) is expected inflation. It therefore follows that,

\[ i^* - i = \pi^{*e} - \pi^e \]
Combining uncovered interest parity with long term purchasing power parity, we see that in the long run nominal interest rate differentials between countries reflect expected inflation differentials.

This is due to the Fisher effect.

The Fisher effect implies that expected inflation does not affect real interest rates, but only nominal ones. For example, if expected inflation is 5% per annum, and the real interest rate (marginal product of capital) is 3%, the nominal interest rate will be equal to 8%. If expected inflation dropped to 2% a year, the nominal interest rate will fall too, from 8% to 5% (3% + 2%).

The Fisher effect is behind the apparent paradox of the monetary approach, which predicts that a permanent increase in nominal interest rates in one country leads to a depreciation of its currency. A permanent rise in nominal interest rates signals a permanent increase in expected and actual inflation. That is why the currency depreciates. Money demand for the currency which is characterized by higher permanent inflation decreases.
Does Purchasing Power Parity Hold?

- The absolute version of purchasing power parity (PPP) does not seem to be compatible with the experience of the long-term evolution of exchange rates and relative price levels. The available evidence suggests that there are large and persistent deviations from PPP.

- If one compares the absolute values of individual tradable goods one also finds significant deviations from the law of one price.

- The relative version of purchasing power parity, the one that stresses rates of change of exchange rates and relative inflation rates, does not seem to be valid either. Deviations are large and exhibit significant persistence as well.
Beyond PPP

- The failure of the theory of purchasing power parity to satisfactorily explain the long-term relationship between nominal exchange rates and relative price levels, leads us to search for a more general theory for the determination of the real exchange rate.

- As we have seen, the real exchange rate is defined as the relative price level of a country relative to the price level of another country, expressed in a common currency.

- The absolute purchasing power parity theory can be considered as a special theory which considers that the real exchange rate is constant in the long run, and that, in fact, it is equal to one.
The Real Exchange Rate

The real exchange rate $Q$ equals the nominal exchange rate $S$, multiplied by the ratio of domestic to foreign price levels.

Thus the real exchange rate of the dollar is defined by,

$$Q = \frac{SP}{P^*}$$
The Nominal and the Real Euro Dollar Exchange Rate
The Real Drachma $ Exchange Rate, 1953-2000
When the nominal exchange rate is defined in dollars per unit of foreign currency, as in the case of the dollar sterling exchange rate, the real exchange rate is defined as,

\[ Q_{\$\text{£}} = \frac{S_{\$\text{£}} P_{\text{UK}}}{P_{\text{US}}} \]
The Real Dollar Sterling Exchange Rate, 1879-2017
The Big Mac Index

The Big Mac index was invented by The Economist in 1986 as a lighthearted guide to whether currencies are at their “correct” level.

It is based on the theory of purchasing-power parity (PPP), the notion that in the long run exchange rates should move towards the rate that would equalise the prices of an identical basket of goods and services (in this case, a burger) in any two countries.

Burgernomics was never intended as a precise gauge of currency misalignment, merely a tool to make exchange-rate theory more digestible. Yet the Big Mac index has become a global standard, included in several economic textbooks and the subject of dozens of academic studies.

The latest version of the index can be found in
Explaining Fluctuations in the Real Exchange Rate

PPP provides a workable model for the explanation of long run trends in nominal exchange rates, but the assumption that real exchange rates are constant, and equal to unity, is an unrealistic assumption.

The question that arises is how are real exchange rates determined in the long run and what are the causes of their fluctuations. For this we have to go beyond PPP.

A starting point is to relax the assumption that there are no costs to international trade. Costs to international trade include transports costs, marketing costs, customs costs etc.
Costs to International Trade and the Real Exchange Rate

Assume that the average per good cost of international trade is $c$ percent of its price.

Then, if $P$ is the price of the good at home in US $, and it costs $c$ percent of its value to ship it abroad, the price of the good abroad, in foreign currency units, will be equal to $SP(1+c)$, where $S$ is the nominal exchange rate (units of domestic currency per unit of foreign currency). The good will be exported, and there will be arbitrage, only as long as

$$SP(1+c) \leq P^*$$

where $P^*$ is the price of the good abroad, in foreign currency.

Analogously, the good will be imported to the US, and there will be arbitrage, only as long as,

$$(P^*/S)(1+c) \leq P$$

These two conditions imply that there will be no arbitrage as long as,

$$1/(1+c) \leq Q = SP/P^* \leq (1+c)$$

Thus, the real exchange rate can deviate from unity, as implied by PPP, to the extent that there are costs to international trade. The higher these costs, the wider the band within which the real exchange rate can fluctuate, without international arbitrage in goods and services taking place.
A Numerical Example: Fluctuation Bands for Real Exchange Rates in the Presence of International Trade Costs

<table>
<thead>
<tr>
<th>c</th>
<th>Fluctuation Band</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>1.10 - 0.90</td>
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<tr>
<td>20%</td>
<td>1.20 - 0.83</td>
</tr>
<tr>
<td>30%</td>
<td>1.30 - 0.77</td>
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<td>40%</td>
<td>1.40 - 0.71</td>
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<td>1.50 - 0.67</td>
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<td>1.60 - 0.62</td>
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<tr>
<td>70%</td>
<td>1.70 - 0.59</td>
</tr>
<tr>
<td>80%</td>
<td>1.80 - 0.56</td>
</tr>
</tbody>
</table>

Typically trade costs are relatively large, for most goods and services and therefore the fluctuation band for real exchange rates is quite large, before international arbitrage in the market for goods and services can set in. Thus, in the presence of costs to international trade deviations from PPP can be quite large and the long run equilibrium real exchange rate may be indeterminate.
What Accounts for Deviations from PPP

- Differences in transport costs and barriers to free trade, such as tariffs and import restrictions, lead to price differences from country to country.

- In addition, each country produces a number of goods and services which are non-tradeable internationally. This is a category of goods and services for which trading costs are infinitely high and thus, they are non-tradeable internationally at almost any exchange rate.

- To the extent that there are cost differences in the production of such goods and services, price levels will differ, even expressed in a single currency.

- Imperfect competition in many markets. Even if the cost of goods was the same, profit margins would not be, to the extent that elasticities of demand differ from country to country.

- Price indices are not identical across countries, as they are based on different "baskets" of goods and services, or different weights for the prices of various products.

- The gradual adjustment of prices of goods and services means that even monetary disturbances can cause fluctuations in the relative price levels of different countries, as different countries are subject to different shocks that call for price changes.
The Role of Non-Traded Goods

There is a category of goods and services for which trading costs are infinitely high. These goods and services are non-tradeable internationally at almost any exchange rate.

Non tradeable goods and services include many perishable goods and most services (domestic services, restaurants, haircuts, health services etc). In addition, the marketing of many otherwise tradeable goods and services requires services that are non tradeable internationally (retailing and other services etc).

The existence of non traded goods and services has significant implications for the determination of the level of prices in different economies, and for the determination of the long run real exchange rate.
We assume there are two countries, Home and Foreign (values for foreign are denoted by asterisks *). Thus \( w \) denotes the Home wage, expressed in the Home currency ($), and \( w^* \) the Foreign wage, expressed in the Foreign currency (€).

The Home exchange rate is \( S \) (units of Foreign currency per unit of Home currency, say, €/$).

1. There are two types of goods in each country. Internationally tradeable, denoted by \( T \), and non-tradeable, denoted by \( N \). Labor is the only factor of production in both sectors, and markets are competitive. Trading costs are zero for tradeables and infinite for non-tradeables.

2. The traded goods has the same price in both countries, when expressed in a common currency. Hence, \( p_T = p^*_T/S = 1 \), in terms of domestic currency ($). The assumption of a unit price in the Home currency is made for simplicity.

3. Wages in each country are determined by productivity in the traded goods sector, and are equal across sectors. Hence, \( w = A \) and \( w^*/S = A^* \). \( A \) and \( A^* \) denote productivity in the Home and Foreign country respectively.

4. Wages in each country determine the prices of non-traded goods, as the productivity in the non-traded goods sector is assumed equal across countries and normalized to unity. Hence, \( p_N = w \) and \( p^*_N = w^* \). As a result, it follows that \( p_N = A \) and \( p^*_N/S = A^* \).

Hence countries with higher productivity will have higher wages, and hence relatively higher prices of non-traded goods. A haircut in the USA should cost more than a haircut in India, because the USA has higher labor productivity in the traded goods sector and, therefore, higher wages. As a result, high productivity (rich) countries they will also have higher price levels.
The price levels in the Home ($p$) and Foreign Country ($p^*$) are defined by,

\[ p = (p_T)^{1-\alpha}(p_N)^\alpha \]
\[ p^* = (p^*_T)^{1-\alpha}(p^*_N)^\alpha \]

$\alpha < 1$ is the share of non traded goods in the two economies, assumed to be the same in both.

From the assumptions of the model it follows that,

\[ p = (A)^\alpha \]
\[ p^*/S = (A^*)^\alpha \]

Hence the country with the higher productivity in the traded goods sector will have a higher price level.

The equilibrium real exchange rate between the two countries is given by,

\[ Q = Sp/p^* = (A/A^*)^\alpha \]

Hence, a rise in productivity in the Home country will result in a real exchange rate appreciation, while a rise in productivity in the Foreign country will result in a real exchange rate depreciation for the Home country.

The Balassa Samuelson model can thus explain why less developed economies have lower price levels than advanced economies, and why during the process of economic development their real exchange rates tend to appreciate.
Wages and Big Mac Prices

(a) Wages and Big Mac Prices

<table>
<thead>
<tr>
<th>Net hourly wage ($)</th>
<th>Big Mac price ($)</th>
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<tbody>
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<td>0</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
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<tr>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>20</td>
<td>4</td>
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George Alogoskoufis, Macroeconomics, 2018-19
GDP per Person and Price Levels
George Alogoskoufis, Macroeconomics, 2018-19

Overvaluation vs Undervaluation

Argentina had high dollar prices, a real overvaluation. Convergence to the target predicts a real depreciation for Argentina (3).

China and Slovakia had low dollar prices, a real undervaluation. They also had relatively fast growth in GDP per person. Convergence to the target plus trend predict a real appreciation for China (1,2) and Slovakia (4,5).

Line of best fit is the target equilibrium real exchange rate according to the Balassa-Samuelson model.
A Model of the Long Run Real Exchange Rate Among Developed Economies

\[ Q = \frac{S \, P}{P^*} \]

- The real exchange rate is nothing else but the relative price of US and EU goods and services expressed in a common currency (the euro in this case).
- PPP is a special theory that considers it to be constant and equal to unity.
- As with any other relative price, a general equilibrium theory of the long run exchange rate would have it being determined by the demand and the supply of US goods and services relative to foreign goods and services.
The Determination of Long Run Real Exchange Rates by Relative Demand and Relative Supply
A Shift of World Demand towards US Goods
An Increase in the Relative Supply of US Goods
A General Model of the Long Run Determination of Nominal Exchange Rates

\[ Q = \frac{S \, P}{P^*} \quad \text{and} \quad S = Q \, \frac{P^*}{P} \]

Making use of the monetary approach,

\[ S = Q \, \frac{M^*}{M} \frac{L(Y^n, i^n)}{L(Y^{*n}, i^{*n})} \]

Thus, a general theory of the determination of long run nominal exchange rates has them being determined by a combination of both real and monetary factors.
Implications of the General Theory of the Medium to Long Run Determination of Nominal Exchange Rates

- Real shifts in the relative demand or supply for US goods affect the real exchange rate of the dollar and therefore lead to changes in the nominal exchange rate even if relative price levels do not change.

- Monetary factors, that affect the relative price level of the US with its trading partners, such as the relative money supply of the relative demand for money affect the nominal exchange rate, even if they do not affect the real exchange rate.

- This general model is much more satisfactory and empirically plausible than simple PPP.