Christiano
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Lecture #7: Exchange Rates in the Long Run (chapter 15 in KG)

1. Introduction.

   Today, we focus exclusively on exchange rate determination in the long run, when P cannot be treated as fixed. Last time we stated as an assumption:

$$M \uparrow \text{ permanently} \Longrightarrow \begin{cases} P, E \uparrow \text{ equipropotionally} \\ R \text{ no change} \end{cases}.$$

   Now, we will derive these and other long run results from deeper assumptions. One reason we will devote a lot of attention to the long run is that, as we say last time, what is expected to happen in the long run has an immediate impact on present variables, like the exchange rate. For example, the short-run effect on the exchange rate of an increase in the money supply that is viewed as permanent is much larger than if it is viewed as temporary.

   The shift from the mixed long run/short run analysis of last time to the pure long run analysis now may at first seem confusing. Later, the short run will be re-integrated into the analysis. For today, the short-run is gone.

   To motivate what we will do, recall two basic relationships that we have been working with:

$$\text{UIP} \quad : \quad R_{\$} = R_{DM} + \frac{E^e - E}{E}$$
$$\text{Money Market} \quad : \quad \frac{M}{P_{\$}} = L(R_{\$}, Y).$$

   Here, we have three variables, $R_{\$}$, E, $P_{\$}$ whose values must be determined by the analysis (they are said to be *endogenous*), but only two relationships. We will need one more relationship (one that does not introduce yet another endogenous variable!) if we are to pin down the three endogenous variables. (By the way, the variables not determined by this analysis, R_{DM}, Y, M, are called exogenous. Later, we will introduce another relationship which will allow us to treat Y as an endogenous variable. But, for now, Y is exogenous - determined by the number of people in the economy, the amount of physical capital and education that they have.)

The extra relationship that we will introduce is called Purchasing Power Parity (PPP). That will be integrated into the above system, which can then be used to determine the endogenous variables. The theory composed of the resulting system of three equations is called the Monetary Approach to the Exchange rate. After this, we'll recognize that PPP is not satisfied very well in the data, and we'll adopt a framework in which PPP is replaced by a suitably more sophisticated relationship.

2. The Monetary Approach to the Exchange Rate

   (a) The Law of One Price. This says that the same good should have the same price, wherever you find it. Thus, if P_G^i is the price of some good called i in Germany and P_{US}^i is the price of the same good in the US, that they have the same price, in dollars, implies:

   $$P_{US}^i = P_G^i E,$$

   where E is the number of dollars per German mark. The idea is that if this equality were violated, say because the left exceeds the right, this would trigger a reduction of demand for the US i^{th} good and an increase in demand for the German i^{th} good. This reallocation of demand would result in some combination of a fall in P_{US}^i, a rise in P_G^i and a rise in E.

   To understand this 'law', it is interesting to look at the box on page 413 of KG. That shows that the dollar price, computed using the above formula, of a McDonald's Big Mac is very different in different countries in the world. One interpretation of the difference is that Big Mac's are really different goods around the world. Each Big Mac represents the services of some poor, unwilling cow, bundled with a lot of locally generated services: transportation, food preparation, a beautiful view, etc. Since these are hard to trade, there would be no force to equalize these prices. Of course, the raw hamburger meat *is* likely to be highly tradeable, and the price of this part of the hamburger should vary less across countries. Where there are trade restrictions, or other factors that hinder transportation, then the price of hamburger meat would also be different. The upshot is that the law of one price should apply internationally only to goods which are easy to ship.

   (b) Purchasing Power Parity. This says that the relationship in the law of one price holds for bundles of goods in different countries. For example, if P_{US} is the consumer price index (CPI) in the US, the P_{US} is the price of a specific bundle of goods in the US. The bundle is composed of the goods that government statistics

determine are bought by the typical family. Suppose P_G is the corresponding price in Germany.
Informally, at least, PPP is sometimes motivated by the Law of One Price. The following example illustrates this.

Example 1 *Here is a case in which the Law of One Price holds, and PPP holds too. Suppose* $P_{US} = a_1 P_{US}^1 + a_2 P_{US}^2$*, where* P_{US}^1 *is the price of good* $i = 1$ *in the US consumption basket and* P_{US}^2 *is the price of good* $i = 2$*. The numbers,* a_1 *and* a_2*, are the fractions of these two goods in the basket. (For the sake of the illustration, I assume there are only two goods in the world.) Suppose, similarly, that* $P_G = a_1 P_G^1 + a_2 P_G^2$*. Also, suppose that the law of one price holds with each good. Then,*

$$\begin{aligned}\frac{P_{US}}{P_G} &= \frac{a_1 P_{US}^1 + a_2 P_{US}^2}{a_1 P_G^1 + a_2 P_G^2} = \frac{a_1 \left(\frac{P_{US}^1}{P_G^1}\right) + a_2 \left(\frac{P_{US}^2}{P_G^1}\right)}{a_1 + a_2 \left(\frac{P_G^2}{P_G^1}\right)} \\ &= \frac{a_1 \left(\frac{P_{US}^1}{P_G^1}\right) + a_2 \left(\frac{P_G^2}{P_G^1}\right)\left(\frac{P_{US}^1}{P_G^2}\right)}{a_1 + a_2 \left(\frac{P_G^2}{P_G^1}\right)} \\ &= E\frac{a_1 + a_2 \left(\frac{P_G^2}{P_G^1}\right)}{a_1 + a_2 \left(\frac{P_G^2}{P_G^1}\right)} = E,\end{aligned}$$

so that PPP holds too.

Example 2 *Here is a case where PPP does not hold, even though the Law of One Price holds for each good. Suppose that the basket of goods in Germany assigns different weights to the two goods (not an implausible assumption, since the typical German and American families do not have identical expenditure patterns). Suppose that in Germany the weight on the first good is* b_1 *and the weight on the second good is* b_2*, where either* $b_1 \neq a_1$*, or* $b_2 \neq a_2$*, or both. Then, going through the same algebra as in the previous example,*

$$\frac{P_{US}}{P_G} = E\frac{a_1 + a_2 \left(\frac{P_G^2}{P_G^1}\right)}{b_1 + b_2 \left(\frac{P_G^2}{P_G^1}\right)} \neq E.$$

This example is not surprising. When the weights are different, the baskets of goods being priced by P_{US} and P_G are different. Even if the law of one price applied to each one individually, we'd still not expect the two baskets to have the same price. Two different shopping bags, one with 3 apples and 2 oranges, and the other with 3 oranges and 2 apples, will not have the same price. This is true, even if the oranges and apples in the two bags individually have the same price.

Example 3 *The previous examples can be adapted to help describe one reason why in the real-world, PPP seems not to hold (i.e.e, $P_{US}/P_G \neq E$). Suppose there are two goods, a traded good and a non-traded good. In the US they have prices P_{US}^T and P_{US}^{NT}, respectively. Similarly, in the foreign country, Japan, they are P_J^T and P_J^{NT} (for this example, the foreign country is being switched to Japan). Suppose that the law of one price holds only for the traded goods, and does not hold for the nontraded. In order to focus sharply on the implications of traded and non-traded goods, suppose the weights in the baskets of goods in the two countries are identical. Then,*

$$\begin{aligned}
\frac{P_{US}}{P_J} &= \frac{a_1 P_{US}^T + a_2 P_{US}^{NT}}{a_1 P_J^T + a_2 P_J^{NT}} \\
&= \frac{a_1 \left(\frac{P_{US}^T}{P_J^T}\right) + a_2 \left(\frac{P_{US}^{NT}}{P_{US}^T}\right)\left(\frac{P_{US}^T}{P_J^T}\right)}{a_1 + a_2 \left(\frac{P_J^{NT}}{P_J^T}\right)} \\
&= E \left[\frac{a_1 + a_2 \left(\frac{P_{US}^{NT}}{P_{US}^T}\right)}{a_1 + a_2 \left(\frac{P_J^{NT}}{P_J^T}\right)} \right].
\end{aligned}$$

Notice that if the term in square brackets were falling in value, then EP_J/P_{US} would be rising. In fact, this has been rising consistently over time. One explanation for this is that P_{US}^{NT}/P_{US}^T is growing less rapidly than P_J^{NT}/P_J^T. KG argue that this reflects that technological progress has been proceeding less rapidly in the Japanese nontraded sector. According to this line, $P_J E$ is able to grow more quickly than P_{US} because the rise in $P_J E$ is accounted for by non-tradeables. If the rise in $P_J E$ were due to tradeables, then it would make no sense that P_{US} is growing faster than $P_J E$. That's because people would buy the tradeables in the US, and ship them to Japan to make a profit.

(c) The Monetary Approach: this combines PPP, UIP and the Money Market.

$$\begin{aligned} \text{UIP} &: \quad R_{\$} = R_{DM} + \frac{E^e - E}{E} \\ \text{Money Market} &: \quad \frac{M}{P_{US}} = L(R_{\$}, Y). \\ \text{PPP} &: \quad \frac{P_G E}{P_{US}} = 1. \end{aligned}$$

We can very quickly derive a result from this, the *Fisher effect.* Note that if $x/y = z$, then

$$\%\Delta z = \%\Delta x - \%\Delta y,$$

where $\%\Delta$ means 'percent change', or,

$$\%\Delta z = \frac{z^e - z}{z},$$

where z^e means z in the next period. Applying this to the PPP relation:

$$\frac{E^e - E}{E} = \pi_{US} - \pi_G,$$

where

$$\pi_{US} = \%\Delta P_{US} = \frac{P_{US}^e - P_{US}}{P_{US}}, \ \pi_G = \%\Delta P_G.$$

This expression says that (in the long run!), the rate of anticipated depreciation is equal to the excess of domestic inflation over foreign inflation. Now, substitute this into UIP to get:

$$R_{\$} = R_{DM} + \pi_{US} - \pi_G.$$

In words, the difference between the domestic and foreign interest rate is equal to the difference between the domestic and foreign inflation rate. This gives us the Fisher effect, because π_G and R_{DM} are exogenous in this relation. So, if π_{US} jumps by x percentage points, then $R_{\$}$ must jump by the same amount. That is the Fisher effect.

(d) To be continued next time....