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C06, Fall 1999
October 27
(10/20 was missed - to be made up on 10/29; 10/26 was the midterm)

Lecture #9: Exchange Rates

1. Analysis of 'More Sophisticated Model' of the Long Run From Last Time (Chapter 15 in KG)

   This model is composed of the money market equation, UIP and a modified version of PPP:

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

   where q is the real exchange rate. We assume that q is determined by demand and supply, in the way discussed in lecture 8.

   In this model, a change in the money stock or its growth rate has the same effect as in the Monetary Approach to the exchange rate. That is because we assume monetary factors don't (in the long run) affect the demand and supply conditions which impact on q. The novelty of this framework is that it can be used to study the impact on E, P_{US} and $R_{\$}$ of a change in q.

   (a) Effects of a change in q. Consider the effect of an increase in world demand for American goods. Suppose it induces a one-time, permanent drop in q, i.e., induces a real appreciation of the dollar. There is no change in the growth rate in q. Now, suppose $R_{\$}$ does not change (we will verify this assumption in a moment). Then, the money market condition says P_{US} does not change either, since the other variables in that relation, M, Y, do not change by assumption (M is determined by the Fed, while Y is determined by the amount of capital and people, etc. in the country). If P_{US} does not change then the real exchange rate relation indicates that E has to jump in proportion to the change in q. That is, E appreciates instantly. But, since there is no change in the growth rate of q or P_{US}, there is no change in $(E^e - E)/E$ either. UIP then implies that $R_{\$}$ does not change, verifying our assumption to this effect, made above.

   The analysis of a change in the supply which affects q is the same. The impact on E, $R_{\$}$ and P_{US}.

(b) Other Implications of the More Sophisticated Model.

i. International Interest Rate Differentials. The real exchange rate expression has the following growth rate implication:

$$\frac{E^e - E}{E} = \frac{q^e - q}{q} + \pi_{US} - \pi_{DM}.$$

That is, the rate of depreciation in the nominal exchange rate is the sum of the depreciation in the real exchange rate, plus the excess of US inflation over that of Germany. Under PPP, real exchange rate depreciation is ruled out. However, the data force us to bring it in. Obviously, the data are characterized by long-term, persistent movements in q. If we substitute this into the interest parity relation, we obtain:

$$R_\$ - R_{DM} = \frac{q^e - q}{q} + \pi_{US} - \pi_{DM}.$$

So, interest rate differentials reflect not just inflation differentials, but also the trend change in the real exchange rate. The Fisher effect continues to hold, as long as the factor increasing π_{US} does not affect $(q^e - q)/q$ (or R_{DM}, π_{DM}, but we already had to assume that before). In this case, a jump in π_{US} shows up one-for-one in the form of a jump in $R_\$$.

ii. There is a different way to write the previous expression for international nominal interest rate differentials. Note that $R_\$ - \pi_{US}$ is the real interest rate in the US and $R_{DM} - \pi_{DM}$ is the real interest rate in Germany.[1] Then, rewriting the last equation, you get:

$$r^e_{US} - r^e_{DM} = \frac{q^e - q}{q},$$

[1]Remember what a real interest rate is. It's the ratio of the goods value of what you earn on an asset, to the goods value of what it costs. Consider a US asset with a nominal return of $1 + R_\$$. The cost of one unit of this asset is one US dollar, which corresonds to $1/P_{US}$ goods. Later, you get back $1 + R_\$$ dollars, which translates into $(1 + R_\$)/P^e_{US}$ goods, where P^e_{US} is the expected price level. Thus, the real rate of return is

$$\frac{(1 + R_\$)/P^e_{US}}{1/P_{US}} = \frac{1 + R_\$}{1 + \pi_{US}} \simeq 1 + R_\$ - \pi_{US},$$

where, $\pi_{US} = (P^e_{US} - P_{US})/P_{US}$.

where $r^e_{US} = R_\$ - \pi_{US}$ is the real interest rate in the US. Thus, the real interest rate differential between two countries is zero if PPP holds (in which case $q^e = q$), or non-zero if q is expected to change.

2. Integrating Output Into the Short Run and the Long Run (Chapter 16).

   (a) Where we stand. Short run: endogenous variables are R and E. We have two relationships to pin these down - the money market condition and UIP. Long run: endogenous variables are P, R and E. We have three relationships to pin these down - the money market condition, UIP and the condition that the real exchange rate, q is determined by exogenous 'demand' and 'supply'. So far, output, Y, has been held fixed at its long-run level, which is determined by the amount of people, capital, education, etc., in the economy.

   We now want to add Y to the list of our model's variables that are endogenous inthe short run. We will stick to our previous assumption that, in the long run, Y is determined by the level of population, education and the quantity of capital. If we are to make Y endogenous in the short run, however, we must add one more relationship, beside just the money market condition and UIP. We will add a goods market relationship.

   (b) Goods Market. Equilibrium in the goods market requires that produced output, Y, be equal to total planned spending, i.e., aggregate demand:

$$\text{Aggregate Demand } D = C(Y-T) + I + G + CA(\frac{EP^*}{P}, Y-T).$$

   Here, planned household consumption, C, is an increasing function of disposable income, $Y-T$,[2] I denotes planned investment and G denotes planned government spending. Also, the planned current account (exports minus imports), CA, is increasing in its first argument and decreasing in its second.[3]

   Be careful to distinguish the goods market equilibrium condition from the national income identity, which must hold whether or not the goods market is in equilibrium. The national income identity

[2] $C(Y-T)$ denotes the consumption function. This is not a number, C, times $Y-T$. It is a function saying how much people with disposable income, $Y-T$, consume.

[3] Again, $CA(\frac{EP^*}{P}, Y-T)$ is a function. The first argument is the real exchange rate and the second is disposable income.

says that total output must be equal to *actual* consumption, plus actual investment, plus actual government spending, plus actual current account. We will assume actual and planned are equal for all components of the national income identity, except investment. So, the economy is in equilibrium if, and only if, planned and actual investment are equal. When the economy is out of equilibrium, a part of actual investment is unplanned. For example, when aggregate demand is less than output, then actual investment exceeds planned investment. The excess of actual over planned is assumed to be composed of an unplanned accumulation of inventories. This makes sense. When demand is low, we'd expect to see goods pile up on store shelves. When aggregate demand is high, then unplanned investment is negative: inventories are disappearing from store shelves.

It is convenient to summarize the Y, E combinations where the goods market is in equilibrium in a graph with E on the vertical axis and Y on the horizontal. This curve is called the DD curve. It's an upward-sloping graph because for higher Y to be a goods market equilibrium requires that aggregate demand be strong. High E does this by making the real exchange rate high. You should understand how the DD curve shifts with T, I, G, P, P^*.

(c) Asset Market. The asset markets are composed of the money market and the international financial market, which is the one that causes the UIP relation to hold. The E, Y combinations where the asset markets are in equilibrium is called the AA curve. It is a negatively sloped curve. That's because at a high level of income, money demand is high, requiring a high rate of interest to clear the money market. But, at a high domestic interest rate you need a low value of E to assure UIP. If US dollar assets are paying a high return, then you need a greater depreciation (smaller appreciation) of the US dollar to make domestic and foreign assets look the same (remember, E^e is held fixed here, so a low E means a high $E^e - E$). You should understand how the AA curve shifts with E^e, P, R^*, M. How does an increase in money demand shift the AA curve? (For a discussion of money demand shocks, read Krugman's story about the Baby Sitting Co-op in Chapter 1 of his book.)

For example, to see how the AA curve shifts with a rise in M, pick a particular point on the horizontal axis in the E, Y graph, a particular value of Y. Then ask, what has to happen to E to restore equilibrium in the asset markets after a rise in M? Other variables, like E^e, that determine the location of AA must be held fixed to know how M shifts AA. So, suppose M rises with Y, holding E^e

fixed. Equilibrium in the money market requires a fall in the rate of interest. Then, UIP requires a rise in E. This is because an appreciation (or smaller depreciation) of the US currency is needed to compensate investors for the low US returns. It is important to emphasize that this logic is not designed to tell us directly what will happen with an increase in M. The logic has the more limited algebraic purpose of telling us what happens to the location of the AA curve with a rise in M. What will actually happen depends on the interaction of the AA and DD curves, something we turn to next.

(d) Putting AA and DD together. Consider various points in the E versus Y graph: points above the AA and DD curve; points above AA but below DD; point below AA and above DD; points below both. Understand what the situation of the economy is at each of these points. Convince yourself that there is just one overall equilibrium, the one where the two curves cross. Points above DD are points were there is excess demand for goods, and we assume that in a situation, output has a tendency to rise (slowly). Points below are the opposite. Points above AA are points were there is a strong demand for the domestic currency, driving E down (instantly); points below are the opposite and drive E up. We assume E always jumps instantly to the A curve, but Y is slower to get to the DD curve. The *disequilibrium dynamics* of a model refer to the assumptions made about what happens when a market is out of equilibrium. Thus, our assumption about disequilibrium dynamics is that the exchange rate, E, moves instantly to clear the asset markets and Y moves slowly to clear the goods market. Given what we know about these markets, this seems like a reasonable assumption.

   i. Temporary increase in M that does not affect the long-run exchange rate, E^e. The first step is to figure out how the AA curve and DD curves shift. From the earlier discussion, we know that the AA curve shifts up. What about the DD curve? Well, M does not appear in that curve, and so it does not move at all.
   So, the AA curve shifts up. This means that the point the economy was at initially is no longer an equilibrium point: the asset market is out of equilibium. Given our assumptions about disequilibrium dynamics, the exchange rate now shoots up to restore equilibrium in the asset markets. Now, however, the goods market is out of equilibrium. The depreciation of the exchange rate puts us above the DD curve, which is a situation of excess demand for goods. The jump in E has produced a real depreciation (q fell) which stimulates the current account. Over time, the excess demand for goods results

in a rise in output. This process continues until we reach a point of intersection between the new AA curve and the old DD curve. We end up with a depreciated exchange rate (which actually overshot a little to get to where it was going) and higher output.

This is exactly what people are urging the Bank of Japan to do today. You can see some of the relevant data in Figures 1a-1c. Note how Japan was growing strongly until 1990 when a severe recession hit. This is a recession that hit the US and other countries too, but Japan never seemed to recover. There has been very little increase in industrial production in the past decade in Japan (industrial production is the best measure of output I could get quickly). Some of the numbers are summarized in the following table. Note how weak Japan's performance has been in the 1990s compared with previous decades, and compared with other developed countries.

Table: Growth Rate, Industrial Production, Japan				
	1960's	1970s	1980s	1990Q1-1998Q1
Japan	13.65	4.86	4.00	0.56
US	5.34	3.00	1.91	2.89
OECD	4.12	3.08	1.64	1.28

Figure 1a shows how the Bank of Japan has been bringing down the interest rate ever since 1990. Although it is not shown in the figure, in 1999 the Bank of Japan actually brought the interest rate down to zero. This evidence suggests the Bank of Japan has been doing all it can to stimulate the economy. Now that the interest rate is zero, you might think that monetary policy can do no more. That is certainly what our framework says. The shift up in the AA curve that occurs with the increase in M involves dropping R (don't forget the UIP and money market conditions that are wrapped up inside the AA curve!). When R hits zero, the central bank can't shift the curve anymore.

The Bank of Japan has not been trying to increase the money supply much lately, beyond keeping the interest rate at zero. Critics argue that the Bank of Japan should increase the money supply more. The Bank's response is that it can't do more once the interest rate hits zero. Critics' response is, maybe monetary policy is ineffective and just maybe it is. So, why not increase the money supply and find out? The critics argue that there isn't much of a down side, and so the Bank of Japan should just do it (the critics are composed of the ministry of finance in Tokyo, as well as some foreigners.)

ii. Increase in Government spending that does not affect E^e. This produces a shift to the right in the DD curve. Since the shock occurs in the relatively sluggish goods market, output takes a little while to get moving (remember the assumptions about disequilibrium dynamics). When output does rise, however, the asset market goes out of equilibrium. results in an appreciation of the exchange rate (US economy in early 1980s under Reagan?).

Fig 1a: Bank of Japan Discount Rate

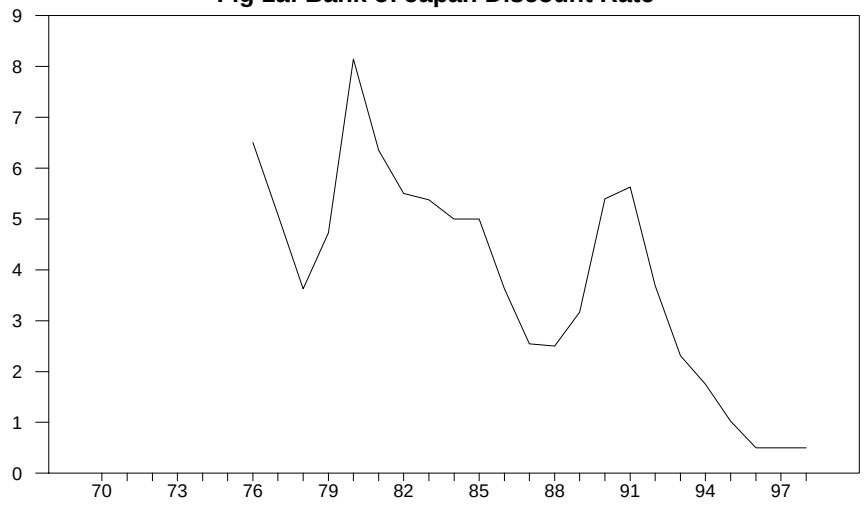

Fig 1c: Growth Rate: Industrial Production

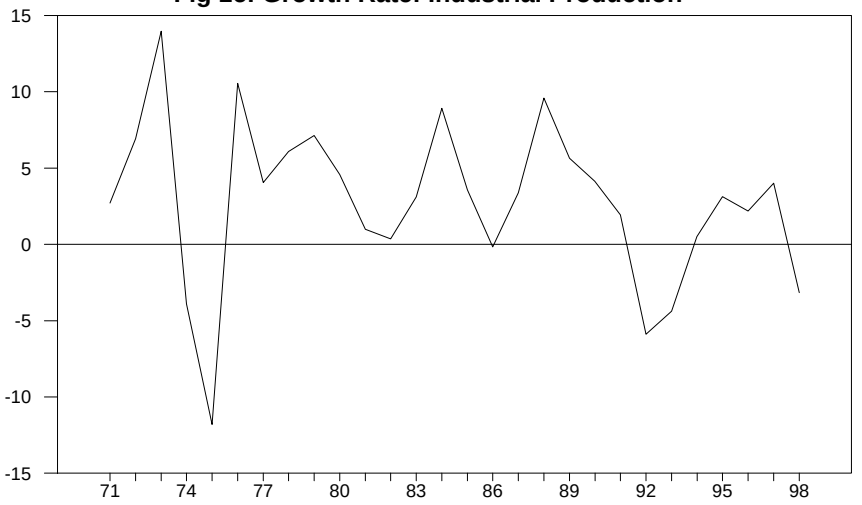

Fig 1b: Industrial Production