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Note: Figures 1-5, 7-9 must be downloaded separately from the web site.
Figure 6 is included in this document.

Lecture #11: The Short and the Long Run.

1. Changes in Government Spending.

Equations of the model:

$$\text{UIP} : R = R^* + \frac{E^e - E}{E}.$$

$$\text{Money Market} : \frac{M}{P} = L(R, Y).$$

$$\text{Goods Market Equilibrium} : Y = D,$$

where D is aggregate demand:

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

In the short run, the variables to be determined are Y, E, R . The variables that are exogenous in short-run are: M, T, I, P^*, P, R^* . The variable, P , is treated as exogenous in the short run because it is assumed to be fixed.

In the long run the variables that are to be determined are E, R, P . The same three equations are used to determine these. Notice that the variables being determined are different now. Y has been dropped from the list and P has been added. Y is dropped because in the long run we assume it is determined by the amount of capital and labor in the economy.

We work out the economic effects of a shock by solving the model 'backward'. First, solve for the long run values of the variables. Then work backwards in time and solve for the short run variables. It has to be done in this way, because one of the variables entering the equations in the short run, E^e , is 'forward looking'. It depends on what happens in the long run.

In doing experiments, it is natural to imagine that we start in an equilibrium where $E^e = E$ and $R = R^*$. This is because, in these experiments we are setting the money growth rate to zero and we are assuming the foreign price level is constant.¹

¹Adjusting the analysis to accommodate ongoing inflation and money growth is easy.

(a) A Short-term rise in G from G_1 to G_2 . Suppose there is a short-term jump in government spending, as in Figure 1.

- i. Nothing happens in the long run. So, E^e remains unchanged after the change in G .
- ii. Now, consider the short run. There are two ways we can work through this. First, consider the aggregate demand curve and the asset markets separately. Represent the asset markets as in Figure 2. In the initial equilibrium, Y_1 , E_1 and R_1 are the levels of output, the exchange rate and the interest rate. Also, $E^e = E_1$ and $R = R^*$. The goods market is represented in Figure 3, with Y on the horizontal axis and Y, D on the vertical axis. D is aggregate demand, and is the curve with slope less than one, while Y itself is captured by the 45 degree line.

Consider what happens to aggregate demand when government spending increases from G_1 to G_2 (represented as $G1$ and $G2$ in Figure 3). The level of income which equilibrates the goods market is now \tilde{Y} (represented as Yt). Of course, the economy does not jump to this level right away. It takes time for output to change. Changing the level of output requires advanced planning. It requires hiring new people. So, the expectation is that output will slowly rise up in the direction of \tilde{Y} . But, note from Figure 2 that this has an effect on the asset markets. First, the increased level of income raises the demand for money, and this puts upward pressure on the rate of interest. And, a rising rate of interest also creates pressures in the international capital markets by threatening to undo UIP.

Consider the international capital markets, summarized by the UIP. As R rises, US dollar denominated assets look more attractive than foreign assets. But, no one will hold foreign assets under these circumstances. Given that R^* is fixed, people will require that there be an expected depreciation of the dollar if they are to hold the foreign assets. That is, they require that E be expected to follow an *upward* trajectory over time. But, everyone also understands at the same time that the long run exchange rate, E^e , remains unchanged under the shock to G . Remember, we assume that E^e coincides with the pre-shock rate of interest, so that $E^e = E_1$ (see Figure 4). For the exchange rate to end up in the long run back at E_1 , and get there by depreciating all the way, requires that the exchange rate drop (appreciate) immediately, and then glide up back towards E_1 , as in Figure 4. The required fall in E is indicated in Figure 2.

So, the rise in G creates, via the money market, upward pressure in R . This in turn, via the international capital markets, creates downward pressure on the level of E . This last factor activates a feedback loop back to the domestic goods market. This is because the drop in E , given the fact that P^* and P are fixed in the short run, also reduces q . The lower value of q has the effect of reducing the current account. (The increased relative cost of domestic goods means that both foreigners and domestic residents will shift some of their demand abroad, and this is what brings CA down.) The effect of this fall in E is to partially offset the positive impact on aggregate demand of the initial rise in G . So, as the economy expands in response to the rise in G , the gap between planned and actual spending is closed in part by the increase in output itself and in part by the reduction in aggregate demand induced by the fall in E . This process continues until the economy stops at a point with a value of E below E_1 , a value of R above R_1 and a value of Y above Y_1 , but below \tilde{Y} . Precisely *where* this process stops is hard to pin down in these graphs. It would be nice if we had a more definitive way to say exactly where the economy will stop.

This is exactly what we get if we translate everything into the AA, DD curve framework. These curves are presented in Figure 5. Their construction was discussed in previous lectures. The increase in G shifts the DD curve to the right. Since the DD curve is constructed from the goods market diagram in Figure 3, it is not surprising that there is a connection between Figures 3 and 5. In particular, the horizontal distance of the DD curve corresponds to the distance from Y_1 to \tilde{Y} . You should verify this for yourself.

Now, after the DD curve shifts, the old equilibrium (Y_1, E_1) is no longer an equilibrium. In particular, there is now excess demand in the goods market (we are now *above* the DD curve). So, an implication of our assumptions about disequilibrium dynamics is that output begins to increase (slowly!) to the right. But, as soon as that happens, the factors in the asset markets that were just discussed come into play. The exchange rate moves down. Every time output shifts right, the exchange rate moves down more. The result is that the economy slides down along the AA curve to the new intersection where the economy is in a short run equilibrium at (Y_2, E_2) . That's the end of the story, for the short run. The analysis is obviously much 'cleaner' in the $AA - DD$ curve framework.

Later, of course, the DD curve must shift back again when G returns to its original value (recall Figure 1). So, the net effect of the temporary jump in G is: a temporary rise in output, a temporary rise in the interest rate and a temporary appreciation of the real and nominal exchange rate. The rise in output is offset somewhat by a temporary increase in the trade deficit.

- iii. The US data in the early 1980s. Figure 6 displays the data for the US for the exchange rate (actually, I have $1/E$ in the figure...also, E here is the trade-weighted average of the exchange rates with all US trading partners). In the early 1980s there was a huge rise in $G - T$, as G went up and T went down. Note that this induced a substantial appreciation in the exchange rate ($1/E$ went up) and the current account went down, consistent with the theory we've just developed. We'll talk later about what happened after 1985, when this pattern was turned around: the current account starts to rise again, and the exchange rate starts to depreciate. Also, note how there is a little delay from the time the exchange rate starts to appreciate in 1980 and the time that the current account starts to fall. We'll talk about this later too.
- (b) A permanent jump in G . Suppose now that the jump in G is permanent, as in Figure 7.
 - i. Consider first the long run effects. Suppose that the increase in G reflects an increase in planned spending on US goods.² By raising the demand for US goods, this is expected to induce a fall in q . Recall the definition of the real exchange rate:

$$q = \frac{EP^*}{P}.$$

So, the fall in q must be associated with a change in E , P^* or P . Recall that P^* is assumed to be determined exogenously, so that won't change. What about P and E ? To figure out what happens to these two variables, we have to figure out what happens to P , E , R , since they are all jointly determined. To see what happens to P , R , E , let's start by supposing that R does not change (we'll check this later). Without a change

²If the increase in G reflected an increase in government spending on foreign produced goods alone, then the rise would produce a simultaneous and equal drop in CA via imports, and there would be no impact on aggregate demand and, hence, no effects on the domestic economy. Recall the discussion early in the course, where we set up the national income and product accounts and were careful to note the distinction between purchases of domestically produced goods and foreign produced goods.

in R (or Y) there cannot be a change in P by the money market condition (since we also assume M is exogenous...it is determined by the Fed). So, P is unchanged. But, with P unchanged, the real exchange rate equation says that E must appreciate by the same percent as q . Now, remember, we're talking here about the long run, some years from now. So, we conclude that some years from now we'll be in a situation where E is at a new lower level permanently. The fact that it shifts down by the same percent in each date in the long run implies that the rate of change in E does not change in the long run, though the level does. But then, according to UIP, the domestic interest rate cannot change, thus confirming our initial 'guess' that R does not change.

Thus, we conclude that in the long run, P , R do not change and E falls. But, can we say how much E falls? Sure. We know that in the long run (as in the short run) the goods market must be in equilibrium. With supply, Y , unchanged, something has to fall in aggregate demand to make room for the rise in G . With our specification of aggregate demand, the only thing that falls is CA . So, q must fall by precisely the amount that leaves $CA + G$ unchanged, i.e., CA must fall by the amount that G rises.

- ii. Now consider the short run. It turns out that the only equilibrium for our economy is for the long run effect of the permanent rise in G to occur *right away*. That is, the exchange rate drops immediately to its long-run lower value and no other endogenous variable - Y , P , R - changes. It is trivial to confirm that the equations that must be satisfied in the short run with this change, are in fact satisfied. It's worth spending some time on this result, since it may seem a little strange at first. This is particularly so because it differs so much from what happens after a temporary rise in G .

One way to establish that output does not rise after a permanent rise in G uses the following simple argument by contradiction. Suppose that, contrary to what we have just argued, output *is* high in the short run after a permanent jump in G . With output high, this requires that the interest rate, R , be high too, given the money demand equation (remember, in the short run, P is fixed). But, with the interest rate high, the UIP requires that the dollar be expected to depreciate. That is, a high R requires $(E^e - E)/E > 0$. But, for the exchange rate to follow an upward-sloping trajectory requires that the immediate drop in E exceed the long-term drop. That is, the exchange must follow a trajectory somewhat like the one in Figure 4, except that it must end up permanently lower. An-

other way of putting it is that the exchange rate drop must *overshoot* the long run drop. But, recall that the long-run drop is precisely the amount that would cause aggregate demand to remain unchanged after the rise in G . It follows that taking into account both the rise in G and the fall in E , aggregate demand actually *falls* in the short run. But, with aggregate demand dropping after the rise in G , we contradict our initial supposition that output is high in the short run. Since the supposition that output rises in the short run after a jump in G generates a contradiction, it is safe to conclude that there is no equilibrium in this model where output experiences a short-run rise after a permanent increase in G .

- (c) The Short Run Effect of a Permanent Rise in G Using the $AA - DD$ model. Let's do the standard $AA - DD$ analysis on this problem and see if it takes us to the same place we just ended up: a permanent jump in G generates *no* short run rise in Y . Consider the AA curve first. Remember, these are the E, Y combinations consistent with asset market (UIP and Money Market) equilibrium, holding E^e, M, P, R^* fixed. The AA curve is exhibited in Figure 8. It shows what happens when E^e drops. Suppose E^e drops from E^e to $E^e(1 - x)$. That is, it drops x percent. What is the vertical drop in the AA curve? That translates into, 'how much does E have to fall at every given level of income, to restore equilibrium in the asset markets?' Since we are holding Y fixed, this means that R is being held fixed (with Y, P, M fixed, there is only one R that satisfies the money demand equation). This means that the answer to this question can be read off the UIP equation by itself. The UIP implies that if E^e falls by x percent, then E must fall by the same percent, to keep UIP consistent with the unchanged R . Thus E must drop to $E(1 - x)$. Because the fall in E is a fixed percent, this translates into a larger absolute magnitude for large values of E . This explains the non-parallel nature of the shift exhibited in Figure 8. Of course, when we focus on the initial equilibrium E, E_1 , then the exchange rate *is* equal to the initial E^e . At this point, equal percent drops translate into equal absolute drops. Thus, at the initial equilibrium level of income, Y_1 , the vertical distance separating the new and old AA curves coincides with the magnitude of the drop in E^e associated with a permanent rise in G .

Now consider the DD curve. Recall that this is composed of the E, Y combinations where the goods market is in equilibrium, for given values of T, I, G, q . The curve is exhibited in Figure 5. We already discussed the horizontal shift in the curve. Right now, the vertical distance of the shift is what is important to us. Recall

what that vertical distance is: it is the amount E has to drop, holding T, I, P^*, P (the latter two are in q) and Y fixed, to restore equilibrium in the goods market given the rise in G from G_1 to G_2 . In percentage terms, this coincides with the drop in E^e associated with the rise in G . But, with $E_1 = E^e$, the drop in E from E_1 is the same, in absolute terms, as the drop in E^e .

We have established that, at Y_1 , the vertical distance of the shift down in the DD and AA curves is identical. Now, our usual analysis is that the economy goes to the intersection of the new AA and DD curves after a shock. In this case, the shock affects the location of both curves. The new intersection corresponds precisely to the equilibrium that we discussed at the very beginning: E drops immediately to its long run value, and nothing else changes.

But, what about our *dynamics*? If we apply the disequilibrium dynamics, do we still end up with this conclusion? Yes, we do. Suppose we are at point 1 in Figure 9. After the shock, this point is above both the new AA and DD curves. The fact that it lies above the DD curve implies that there is pressure for output to rise, for the economy to move to the right of point 1. The fact that point 1 lies above the AA curve means that there is pressure for the exchange rate to fall. Now, recall our assumption that the asset markets clear instantaneously, while it takes time to resolve disequilibrium in the goods market. This implies that before output has any chance even to move, the exchange rate will drop from 1 to 2. Once the economy is at 2, all markets are in equilibrium and that's where the economy will stop.

(d) Some Simple Intuition Behind the G Results.

Does our result make any *sense*? Does it make sense that output does not rise after a permanent rise in G ? Here is some intuition. In general, the reason short run effects differ from long run effects in our model has to do with the fact that in the long run the price level is flexible, while it is fixed in the short run. Another feature of the short run is that output is slow to move to equilibrium. But, the long run equilibrium requires *no* change in output and *no* change in the price level. All it requires is a change in an asset market variable, E . There is no reason that change can't be implemented by the economy in a matter of hours. The point is that there is just nothing stopping the economy from going to the long run equilibrium immediately.

2. J-Curve.

At least the short run part of the previous discussion depends on there being a tight, contemporaneous, connection between q and CA . When

we think about CA more carefully, we find that that connection may not be so tight.

Recall what the current account is:

$$CA = \text{stuff sent abroad} - \text{stuff imported from abroad.}$$

Both parts of this have to be measured in the same units. In practice, they are measured in units of domestically produced goods. Generally, we have tried to avoid thinking in detail about the multiplicity of goods out there. But, now we really can't avoid it. In the current account, there are foreign and domestic goods. We need to recognize this. But, let's do so without getting involved in all the complicated details that dealing with lot's of goods requires. The simplest thing we can do is just assume there are two goods: Americans produce apples and foreigners produce oranges. Then,

$$CA = \text{apples sent abroad} - \text{apple value of oranges imported from abroad.}$$

The notation we have used for 'apples sent abroad' is EX . The oranges imported from abroad correspond to foreigners' exports. So, it makes sense to call this EX^* (often, the foreign value of a variable is indicated by an asterisk). Then:

$$CA = EX(q) - q \times EX^*(q, Y - T).$$

Here, we indicate that EX is a function of q , the price of oranges, divided by the price of apples. Similarly, EX^* , the oranges imported from abroad is a function of q and $Y - T$, the relative price and the disposable income of domestic residents. We don't include $Y - T$ in EX , because EX is decided by foreigners and so it is a function of their $Y - T$. But, we treat that as exogenous, and so we don't even bother to include it explicitly in the notation.

Why is the current account specifically $EX - q \times EX^*$? Why is the q in this expression? It's because $q \times EX^*$ is the apple value of oranges imported from abroad. To see this, note first that $P^* \times EX^*$ is the foreign currency value of imported oranges. Then, $E \times P^* \times EX^*$ is the value of imported oranges in domestic (i.e., US dollar) units. Finally, $E \times P^* \times EX^* / P$ converts this US dollar value into quantities of US goods. For example, if you had \$100 and the price of US goods (i.e., apples) were $P = 2$, then the goods value of the \$100 is $\$100 / P = 50$ units of goods. But, $E \times P^* / P$ is just q . This explains why $q \times EX^*$ appears in the expression for the current account.

Now, it makes sense to think of $EX(q)$ as increasing in q and EX^* as decreasing in q . When oranges get relatively more expensive compared

to apples (i.e., q rises) then the amount of apples sold to foreigners will rise (i.e., EX will rise) and the amount of oranges bought from foreigners will fall (i.e., EX^* will fall). Notice that this is *almost* enough to get the result that CA is increasing in q . It is not quite enough because the rise in q itself, other things the same, drives CA *down*. When we assumed before that CA is increasing in q we were implicitly assuming that this latter effect of q has a smaller impact on CA than the effect of q on CA via EX and EX^* . We will continue to maintain this assumption in the long run. Empirical analysis suggests that this is appropriate.

However, the same empirical analyses suggests that the assumption that CA is increasing in q may not be appropriate for the short run of 6-months to a year or so. The reason is that in the short run variables like EX and EX^* are slow to adjust. To some extent, these variables are determined by long-run plans that, absent a dramatic change in circumstances, do not get changed right away when q changes. The idea is that when a change in q occurs that is in fact quite persistent, then EX and EX^* don't change at first, and then they change after a while. Under these circumstances, it follows that in the short run CA *falls* with a rise in q , and then when EX and EX^* have a chance to adjust, the rise that we have been assuming all along occurs.

Fig. 6: Nominal US exchange rate and current account

Trade Weighted Exchange Rate (right scale), CA/GDP (left scale)

