

Christiano  
C06, Fall 1999  
November 10.

(Note: there are 9 figures that go with this lecture. They are created by Microsoft Paint and in \*.jpg format. Instructions for downloading and printing are on the web site. I will print those files and bring hardcopy to class.)

### Lecture #14: Fixed Exchange Rates

The purpose of this lecture is to discuss the operating characteristics of fixed exchange rates. We find that under fixed exchange rates, the central bank can deal nicely with domestic shocks to money demand. However, flexible exchange rate regimes interfere with a central bank's ability to respond to shocks to aggregate demand. These problems can be mitigated to the extent that shocks are correlated across the countries with respect to which the exchange rate is fixed. The purpose of these notes is to clarify the logic underlying these statements. After, there is a discussion of the implications for recent economic events.

Last time, we derived the following result: under a fixed exchange rate regime, the monetary authority has to manipulate the money supply so that, regardless of what shock hits, the domestic interest is equated to the foreign interest rate,  $R^*$ . We then examined how this policy works in the face of a shock to money demand and a shock to aggregate demand. We found that, in the case of a shock to money demand, the central bank simply has to conduct open market operations to change  $M$  in such a way to guarantee that

$$\frac{M}{P} = L(R, Y),$$

is always satisfied at unchanged  $R$  and  $Y$ . This means that if money demand rises, then the money supply must be increased by enough to meet the increased demand. If money demand falls,  $M$  must be reduced by the same amount. When there are money demand shocks, a fixed exchange rate regime works well, since it serves to insulate the economy completely against the shocks.

But, the story can be quite different if there are other shocks. To show this, we consider shocks to aggregate demand and a shock to the foreign interest rate,  $R^*$ . I will establish the following results:

- Suppose there is a bad shock to aggregate demand. In our model, the fixed exchange rate regime requires that the monetary authority magnify the shock's depressive effect on output by adopting a tight monetary policy. Suppose the foreign country, with whom we have our fixed exchange rate, *also* experiences the drop in aggregate demand, i.e., our drop in aggregate demand is *correlated* with their drop. In the model of the class, it makes no difference whether or not the shock is

correlated in this way. However, there are two plausible modifications to the model, either of which implies that a correlated shock may *not* be a very bad thing under a fixed exchange rate regime. One of these modifications adopts the (reasonable!) assumption that an increase in  $R$  reduces aggregate demand.

- If  $R^*$  jumps, then the fixed exchange rate regime requires that  $R$  rise by the same amount. In our model, when this happens there is no effect on aggregate output,  $Y$ , or on its components. However, if we adopt the modification mentioned above, that aggregate demand falls with a rise in  $R$ , then when  $R^*$  rises, the fixed exchange rate regime requires that the monetary authority respond by producing a recession.

We now consider each of these bullets in turn: first, the shock to aggregate demand and then the shock to  $R^*$ . After that we consider why the results in the two bullets are interesting.

1. Shock to Aggregate Demand. In this case, we showed in lecture 13 that what the central bank would like to do - but cannot under a fixed exchange rate system - is to increase the money supply and produce a depreciation of the currency. This is exhibited in Figure 1, which shows the shift up in the  $AA$  curve that occurs with an increase in the money supply. Note that with this policy response, the exchange rate depreciates from  $E1$  to  $E2$ . This depreciation produces the rise in the current account needed to exactly cancel the initial fall in aggregate demand.

But, under a fixed exchange rate regime, the central bank commits itself to keeping the exchange rate fixed at  $E1$ . So, instead of increasing the money supply, the central bank must actually contract the money supply in response to the shock. It must, in effect, do the *opposite* of what it would like to do if its primary concern were with stabilizing output. As it stands, the objective of stabilizing output conflicts sharply with the objective of maintaining the fixed exchange rate. If this were the end of the story, it would be hard to see why countries would ever contemplate fixing their exchange rates with other countries.

Of course, it is not the end of the story. If the country with which we fix our exchange rate also experiences the bad aggregate demand shock, then it may be that the fixed exchange rate regime isn't so bad after all. To explain this, I will consider three versions of the model. The first version is just the standard model (the 'standard case') we've been using up to now: there are two countries in the world, the foreign and the domestic, and there are three equations characterizing the domestic economy's equilibrium: UIP, the money market equilibrium condition, and the goods market equilibrium condition.

In the second version of the model (the ‘multiple country case’), we imagine that the country with which we fix our exchange rate is only one of many other countries. Neither we, nor our partner country, has fixed exchange rates with these other countries. This is a good way to think of a country, say France, in the European Union. France’s exchange rate is fixed relative to the other countries in the union (think of the other countries as just one big ‘other’ country), but not relative to the other countries in the world that are not part of the union (e.g., the US).

In the third version of the model (the ‘interest-sensitive case’), we adopt a different specification of the aggregate demand curve, one in which aggregate demand falls with a rise in the nominal rate of interest. I imagine this reflects a negative response in household planned spending and/or a negative response in planned investment, in response to a rise in  $R$ . This latter in particular is a very sensible assumption. Incorporating this assumption complicates the analysis slightly, and this is why it has not been done up to now. Also, it hasn’t really mattered for the basic conclusions. However, it does matter now. So, now we bite the bullet and consider this assumption explicitly.

Following is the analysis in the three versions of the model just described. In each case, we assume that the country with which our exchange rate is fixed also experiences the bad shock to aggregate demand.

- (a) The standard case. Suppose that the foreign country responds to the fall in aggregate demand by cutting its interest rate,  $R^*$ .<sup>1</sup> What happens, under these circumstances, to the domestic economy, given that its central bank has to defend the fixed exchange rate?

The first issue is, what happens to the  $AA$  curve when  $R^*$  falls? Figure 2 shows the financial markets, with the money market on the right and the UIP on the left. It is easy to verify that UIP requires that the curve in the left graph shift down exactly by the amount of the fall in  $R^*$  (the difference between  $R_p$  and  $R_1$  in the figure is the difference between the new and the old  $R^*$ ). But, this means that, given  $Y$ , a lower  $E$  (see the fall in  $E$  from  $E_1$  to  $E_2$ ) is required to clear both the money and international financial markets. The upshot is that the  $AA$  curve shifts *down* when the foreign central bank reduces  $R^*$ . The effect can be seen in Figure 3, which shows the shift down in  $AA$ , to  $AA_1$ , produced by a fall in  $R^*$ .

---

<sup>1</sup>The logic of the analysis that follows does not depend on the reasons why the foreign country reduces the rate of interest.

Now, combine the down-shifting  $AA$  curve with the left-shifting  $DD$  curve, as in Figure 4. We suppose that the economy starts out at point 1, where output is  $Y1$  and the exchange rate is  $E1$ . Note how the  $AA$  curve shifts up with the reduction in  $R^*$  and how the  $DD$  curve shifts left, reflecting the negative shock to aggregate demand.

To preserve the fixed exchange rate, the central bank must adjust  $M$  to move the  $AA$  curve so that new  $DD$  curve (see  $DD2$ ) intersects the  $AA$  curve at the fixed exchange rate,  $E1$ . (see point 2 in Figure 4). When it has done so, the equilibrium level and composition of output is *exactly* where it would have been if we had not been thinking about the case in which the foreign country responds with an interest rate cut. Of course, the interest rate is lower in this equilibrium (it's equal to the now lower foreign rate of interest). But, this is immaterial, since  $R$  plays no role in the goods market in the standard version of our model.

It is interesting to note that it is unclear whether the domestic central bank has to increase or decrease the money supply in the face of a bad aggregate demand shock, when the foreign country cuts its interest rate. It depends on how far down the foreign country's interest rate cut shifts the  $AA$  curve. In the situation depicted in Figure 4, the foreign central bank's action has only moved the  $AA$  curve down part way, so that a cut in  $M$  is required to move it the rest of the way. If the foreign central bank's interest rate cut had placed the  $AA1$  curve below point 2, then an increase in  $M$  would have been needed. Of course, if by some twist of fate, the foreign interest rate cut had caused the  $AA1$  curve to intersect the new  $DD$  curve at point 2, then *no* monetary response by the domestic central bank would have been required.

- (b) Consider the multiple country case mentioned above. Suppose now that the partner country with which we fix our exchange rate experiences the same shock that we do. Then, that country probably wouldn't mind depreciating its currency relative to the rest of the world, just like we would like to. It's likely that the two countries could form an agreement and cut their interest rates in a way that preserves the fixed exchange rate between the two of them, but depreciates their currencies relative to the rest of the world. In this way, the countries both run deficits against the rest of the world, and achieve a result like that in Figure 1. The formal analysis would simply treat the two countries as one country and literally proceed as in Figure 1.
- (c) Now consider the interest sensitive case mentioned above. That is, we now think of the  $DD$  curve as shifting right with a fall in  $R$ . Here is one way to think through this exercise. Start by forgetting

that there is a second country and that the central bank is on a fixed exchange rate regime. Suppose for now that  $M$  is kept constant.

As before, suppose a shock shifts  $DD$  to the left by some amount. If  $DD$  were insensitive to  $R$ , then the economy would just move from 1 to 2 in Figure 5. But, in the case where  $DD$  is sensitive to  $R$ , then as the economy travels up the  $AA$  curve towards point 2, the  $DD$  curve starts shifting back with the fall in the rate of interest.<sup>2</sup> The right-shifting  $DD$  curve would meet the economy which is travelling northwest along the  $AA$  curve at some intermediate point like 3, where the economy would come to a stop and be in an equilibrium.

But remember now that the exercise we just did oversimplifies in two respects: we dropped the idea that the foreign central bank cuts  $R^*$  and that the domestic central bank fixes the exchange rate. Let's fix these two omissions.

It should be obvious that there is some rate of interest, lower than the value that prevails at point 3 in Figure 5, that shifts the  $DD$  curve right, until it crosses through point 1 in Figure 5. Of course, to preserve UIP, this would require that the foreign central bank also set its interest rate to this value. And, this would move the  $AA$  curve. But, remember that the domestic central bank can put that  $AA$  curve anywhere it wants simply by a suitable choice of  $M$ .

So, the way for the two countries to go is to set their interest rates to the point where the  $DD$  curve crosses point 1 in Figure 5, and then the domestic central bank should adjust the  $AA$  curve so that it crosses through point 1 too. In this way, the coordinated policy across the two countries succeeds in stabilizing the aggregate demand shock, without departing from the fixed exchange rate regime.

It might be easier to see this argument simply by looking directly at the equations of the model:

$$\begin{aligned}\frac{M}{P} &= L(R, Y), \\ R &= R^* \\ Y &= D(Y - T, R, \frac{EP^*}{P}).\end{aligned}$$

Here, the first equation is our usual money market equilibrium condition (money supply equals money demand). The middle equation is UIP, with fixed exchange rates imposed (so that  $(E^e -$

---

<sup>2</sup>Convince yourself that as we move northwest along the  $AA$  curve,  $R$  falls.

$E)/E = 0)$ . The last equation is the equilibrium condition in the goods market.<sup>3</sup> The shock has the effect of reducing  $D$  for each value of  $Y - T$ ,  $R$  and  $q$ . Given the initial equilibrium values of  $Y$ ,  $E$  and  $P$ , there is a value of  $R$  that will restore equilibrium in the goods market. As long as the foreign central bank sets  $R^*$  to this value, and the domestic central bank does so too by suitable adjustment in the first equation, then the first two of the above three equations are satisfied. Moreover, by construction, equilibrium in the goods market continues to exist for the old values of  $q$  and  $Y - T$ . One way to see what value of the interest rate is needed to preserve equilibrium in the goods market can be seen in Figure 6. The figure shows the drop in aggregate demand for a fixed  $R$ ,  $q$  and  $T$ . The old aggregate demand curve is denoted  $D$  and the new one,  $Dp$ . The interest rate that is required is the one that shifts the  $Dp$  curve back up to where it intersects the 45 degree line at point 1.

- (d) A summing up. The preceding discussion considered the case where an aggregate demand shock is correlated across countries that maintain a fixed exchange rate among each other. In this case, the countries can stabilize the output effect of the shock by engineering a coordinated drop in their interest rates. If done right, this preserves the fixed exchange rates among the countries. But, it results in a depreciation of their exchange rates with respect to the rest of the world. That can stimulate aggregate demand among the countries by driving up their current accounts with respect to the rest of the world. It can also stimulate aggregate demand if planned spending increases with a fall in the rate of interest.

2. Suppose now that the foreign rate of interest,  $R^*$ , rises. This could be because aggregate demand in the foreign country is high. But, the exact reason does not matter.

We'll analyze the effects of the shock in the foreign interest rate under two circumstances. First, we'll consider the case where aggregate de-

---

<sup>3</sup>Here,  $D(Y - T, R, \frac{EP^*}{P})$  denotes aggregate demand:

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

where  $C$  and  $I$  are negatively related to  $R$ . Perhaps  $CA$  could also be made a function of  $R$ . As noted in the text, for our present purposes the exact way in which a higher  $R$  reduces  $D$  does not matter.

mand is not sensitive to the interest rate. Then, we'll look at the case where it is.

(a) The Standard Case.

Figure 7 displays the impact on the  $AA$  curve of the increase in  $R^*$ . It shifts up. If the domestic monetary authority keeps the money stock fixed, and doesn't worry about the fixed exchange rate regime, then the economy can be expected to travel the path indicated by the arrows, from 1 to 2. Initially, there is a large depreciation of the exchange rate because this is needed to reconcile the higher foreign interest rate with the low domestic interest rate: there must be an anticipated appreciation of the domestic currency, and for  $E$  to fall over time, given that its long run level is unaffected, requires an immediate jump in  $E$ . With the jump in  $E$ , the stimulus to  $CA$  starts sending output up. The rise in output raises  $R$  and thus brings  $E$  down somewhat, and that's what's going on as we slide down the new  $AA$  curve towards point 2.

But, now suppose we recognize that there is a fixed exchange rate regime in place. Then, the monetary authority must reduce the money supply and bring the  $AA$  curve back down, so that it intersects point 1 in Figure 7. Note that once we have returned to this point, nothing has happened, really. The level and composition of output is what it was before. True, the rate of interest is higher, but this does not matter for output because planned spending is not sensitive to the interest rate in the standard model.

(b) The interest rate sensitive case.

Now let's repeat the previous exercise under the assumption that aggregate demand responds negatively to the rate of interest. Let's proceed in the same style we have before, by first ignoring the fixed exchange rate regime. Thus, consider Figure 8. The rise in  $R^*$  shifts the  $AA$  curve up, just like before. However, now, as the economy begins its slide down the new  $AA$  curve, and  $R$  is rising, the  $DD$  curve begins to shift left. This pattern is indicated by the left arrow in Figure 8. The economy travels southeast along the  $AA$  curve and eventually meets the left-shifting  $DD$  curve. When it meets, that's equilibrium. It is denoted by point 3. Note that at this point, output is lower than it was before. The reason is that the higher interest rate depresses aggregate demand.

But now let's recognize that there is a fixed exchange rate regime in place. Point 3 in Figure 8 is obviously not consistent with the fixed exchange rate regime because  $E$  is too high. The exchange rate needs to be brought back to its original level, indicated as  $E1$  in Figure 9. To do this, the central bank must tighten monetary policy and shift the  $AA$  curve down from its level at  $AA2$ . As the

$AA$  curve shifts down the economy rides the intersection of the  $AA$  curve and the  $DD$  curve. On this path,  $E$  falls, and  $R$  rises. The latter means that the  $DD$  curve is simultaneously shifting left. As a result, the economy traces the path indicated by the arrow from point 3 to point 4. The  $DD$  curve at the end of this path is indicated by  $DD3$ , and the  $AA$  curve is  $AA3$ . Note that the original exchange rate has been restored at point 4, so that the fixed exchange rate regime is preserved. However, the net effect of the rise in  $R^*$  has been to reduce output from  $Y1$  to  $Y2$ .

In sum, when the other country raises its interest rate and the domestic economy is committed to a fixed exchange rate, then the domestic economy has to raise its interest rate too. This will cause a recession in the plausible case where planned spending falls with a rise in the interest rate.

3. Who Cares? The above discussion reviewed some of the characteristics of a fixed exchange rate regime. Essentially, it requires that you maintain the interest rate at the level in the foreign country. This has several consequences. Under a fixed exchange rate regime:

- Your response to domestic shocks to money demand is excellent.
- If the foreign country's rate of interest rises, you may be in for a recession as you are forced to raise your interest rate too.
- If there is a fall in aggregate demand in your country, the fixed exchange rate regime may hinder your ability to stabilize the output effects. You can get around this, to the extent that you can arrange suitable coordinated interest rate changes with your partner countries in the fixed exchange rate system.

These bullets, especially the last two, have important implications. Here are some of them:

- (a) The theory of optimal currency areas. Clearly, a big downside to fixed exchange rates is that it frustrates a central bank's ability to deal with aggregate demand shocks. The last bullet indicates, however, that if you can establish fixed exchange rate regimes with countries whose aggregate demand shocks are correlated with yours, then the fixed exchange rate regime is more likely to be successful. This logic is an important ingredient in the 'theory of optimal currency areas', for which the Nobel prize was recently awarded to Robert Mundel of Columbia University. According to this theory, countries ought to form a currency union (an extreme



form of fixed exchange rates) if their shocks are appropriately correlated.<sup>4</sup>

The issue of how well shocks are correlated is a factor in discussions about the likely success of the planned monetary union in Europe (see more below). Other monetary unions are also under discussion. For example, one plan would put North and South America on a common fixed exchange rate regime. These discussions involve, in part, assessments of how well shocks are correlated across countries. For example, non-US countries like Canada, Mexico, etc., are relatively sensitive to shocks to commodity demand. Suppose the non-US countries are in recessions because world demand for commodities is low. But, suppose that at the same time, the US is in a boom and the Federal Reserve decides to raise interest rates because it is concerned about inflation. The other countries in the western hemisphere would have to raise their rates at the same time, and they just might find this intolerable. This is the kind of consideration that makes them hesitant to join a union in the first place.

- (b) Mexico in 1994. In 1994, the US Fed raised interest rates sharply throughout the year (look at figure 8 from lecture 12). Mexico was therefore obliged to raise its interest rates because it was committed to a fixed exchange rate with respect to the US dollar. But, this came at a bad time, when there was a presidential election underway. By the end of the year, the Mexicans abandoned the fixed exchange rate regime. The full story behind the Mexican depreciation is more complicated than this. But, most would agree that the US rise in interest rates was a contributing factor to Mexico's abandoning its fixed exchange rate with the dollar.
- (c) The third bullet points to an important issue in assessing the likely success of the European Monetary Union. If the shocks across countries are not well correlated, then sticking to a fixed exchange rate among the countries may turn out to be too difficult. The experience in 1992 is a case in point. The rate of interest in Germany, the leading economic power in Europe, had been rising due to strong aggregate demand related to the reunification of East and West Germany. Because of the fixed exchange rate system then in place, this forced the other countries in Europe to also raise their interest rates. This generated much stress and

---

<sup>4</sup>A currency union is a region, like the United States, where there is only one currency. You can think of this as a multiple currency area with fixed exchange rates. Actually, in the US there are 12 different currencies, according to which Federal Reserve bank issued it (check out your bank notes, they indicate which Federal Reserve District they come from). The exchange rate between these currencies is fixed at unity. The Europeans are already well on their way towards a currency union.

controversy across Europe because the high interest rates had a depressive effect on the various economies. In the end, Italy and Britain abandoned the fixed exchange rate system because the high interest rates proved to be too much for them.

A primary motivation for European monetary integration is to promote political and cultural integration in Europe and thereby hopefully reduce the likelihood of future military conflicts of the type that have been observed in the past. The third bullet indicates that, ironically, monetary union could itself become a *source* of stress in Europe, if shocks are sufficiently uncorrelated across the countries. On the bright side, the US has managed to do quite well with its experiment in monetary integration, even though shocks across regions of the US are obviously not well correlated (oil shocks affect the oil producing states differently than the oil consuming states, military spending affects different regions differently, etc.). But, it is not clear how good a model the US is for Europe. In the US, political integration *preceded* monetary integration. In Europe, they are trying to proceed in the opposite direction.