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362, Winter, 2006

Lecture #16: Currency Crisis

The focus of this class is on currency crisis. This happens when the government says it is committed to maintaining a particular value for the exchange rate, but private markets don't believe the central bank will succeed. They believe that for one reason or another, there will be a devaluation soon. A central bank that acts to preserve its target value of the exchange rate under these circumstances is said to be 'defending' the exchange rate. The UIP relation indicates that a defense requires raising the domestic nominal rate of interest. Otherwise, market participants who believe the exchange rate will devalue soon, will sell the domestic currency with the objective of acquiring the foreign currency necessary to purchase higher-yielding foreign financial assets. Even a relatively small expected devaluation could produce a huge 'run for the exits' as traders attempt to sell domestic currency. Such a 'run for the exits' is sometimes referred to as an 'attack' on the currency.

Defending against an attack can be quite costly, since it can require raising the interest rate a lot. For example, if people expect a 10 percent depreciation with 50 percent probability in the next month, domestic interest rates will have to be higher by 5 percentage points, at a *monthly* rate (i.e., 60 percentage points, annual rate!). Interest rate increases of this magnitude can do significant damage to the economy, both by reducing investment via the usual channels, and by doing damage to bank balance sheets, inhibiting them from doing their business of transmitting funds from savers to entrepreneurs who borrow to fund investment. These large interest rate changes needed to defend against a currency attack are based on the UIP relation. The outcome of these calculations are so unpleasant, that it doesn't seem unreasonable to refer to this as the *Curse of the UIP*. Market participants who think that the Curse of the UIP will inhibit a central banker from putting up a strong defense, may be encouraged to press the attack even more vigorously.

The purpose of this lecture is to explore these ideas in our AA-DD curve framework.

1. Defending the fixed exchange rate when E^e jumps.

   Recall, under a fixed exchange rate system, the central bank has to move the money supply so that the AA curve intersects the DD curve at the targeted value of the exchange rate.

   (a) The standard model.

   To defend the fixed exchange rate, E_0, the monetary authority must decrease the money supply and raise the interest rate. We first consider the economic effects of this in the context of the

'standard model', the one in which aggregate demand is not a function of the interest rate. The monetary authority has to raise the domestic interest rate by enough so that traders are compensated for the depreciation of the currency that they expect. That is, the interest rate must be $R = R^* + (E^e - E_0)/E_0$, where E^e is the exchange rate that traders expect to prevail in the future ($E^e > E_0$). The interest rate must jump in the amount, $(E^e - E_0)/E_0$. Otherwise, traders will 'attack' the domestic currency by attempting to sell it in exchange for some other currency, in the hopes of benefitting from higher expected interest rates in other countries. The central bank that is committed to E_0 must defend against the attack by raising R enough (they do this by reducing M, of course.) In the standard model, a defense against attack is basically costless to the central bank, because a high interest rate has no bad effects on the domestic economy.

(b) The model in which aggregate demand is a decreasing function of R.
There are several important real-world features that are left out of the standard model. The key one is that in practice, aggregate demand is a decreasing function of the rate of interest. When we take this into account, we begin to get a glimpse into why it is that currency crises strike fear into the hearts of central bankers.
To see what happens when E^e jumps in the model where aggregate demand is a decreasing function of R, consider the $AA-DD$ curve diagram in Figure 1. The effect of the jump in E^e, as explained in Figure 17-5 of the book, is to raise the AA curve up to AA'. In the standard model, the monetary authority who wants to defend the exchange rate, E_0, has to shift the AA curve back down to where it was before, by reducing M. In the model where aggregate demand is a decreasing function of the interest rate, the rise in R occurring with the fall in M has the effect of shifting the DD curve to the left.[1] As a result, the economy settles at an equilibrium to the left of the point where it started out. The economy moves from point 1 to point 2. The way to think about how this happens is like this. To defend the interest rate, E_0, the monetary authority must raise the domestic interest rate by moving the AA curve from AA' back to $AA2$. This higher interest rate makes the DD curve shift left and hurts output and employment. Now, we begin to see why a rise in E^e is a worry to central bankers.

2. Reasons Why Central Bankers Don't Like to Raise Rates.

[1]Make sure you understand why this is so. Remember the definition of the DD curve and then work out carefully, why a rise in R would shift it left.

The previous discussion brings out why defending a currency against a rise in E^e might be painful: the necessary rise in R can reduce the interest-sensitive components of demand, and help produce a recession.

Another reason why it might be costly for the central bank to raise the interest rate is that this could do damage to the banking system. Central banks are very concerned to not damage the banking system, because banks are between essentially every transaction that occurs in the economy. Banks are a little like the oxygen we breath: normally you don't even notice it, but when it's gone everything comes to a halt within seconds! Damage to the banking system can negatively affect output through two channels: demand and supply. On the demand side, one of the things that banks do is to connect borrowers (i.e., the firms that invest and households who buy durable goods using bank loans) with lenders. If you damage the institution where these people meet, then there will be less demand for investment goods and household durables. The economic consequences are captured by a shift left in the DD curve. Damage to the banking system also has an impact on the supply side of the economy. When the banking system is not functioning properly, it is difficult for firms to pay their workers and other suppliers. When this happens, firms are forced to cut back on production. Our model is not well designed to capture these supply side effects on output in the short run. It focusses on the short run effects of demand-side shocks. The short run impact of a damaged banking system through the supply side of the economy is something our model misses. Still, it is not something we should ignore.

Now, let's review the ways in which a high interest rate could do damage to the banking system. Before describing them, let us first look at a bank balance sheet:

Assets	Liabilities
Loans 100	Deposits 90
	Net Worth 10

This balance sheet is quite simple. Still it captures the basic elements of any bank balance sheet. On the asset side, banks make loans. In the example, it has loaned out \$100. In reality, the 'loans' side of the balance sheet consists of a wide range of assets, from loans to households to improve their kitchens, to loans to businesses. In addition, 'loans' includes such things as deposits that the bank holds with the central bank. Banks hold deposits with the central bank, because these are helpful in making payments to other banks. Banks make payments to other banks when checks written by depositors end up in other banks and they are presented for payment. So, the details of the Asset side of the bank balance sheet are complicated. The key thing, however, is

that the vast majority of things on the asset side of the balance sheet are financial instruments that pay interest. For the sake of the example, let's suppose the interest rate is 5 percent. So, the bank can expect to earn \$5 per period on its assets.

Of course, the bank has to get the money that it uses to buy its assets from somewhere. Where it gets its money from can be seen on the liabilities side of the balance sheet. The two main categories of liabilities are 'deposits' and 'net worth'. Deposits consist of a variety of financial objects. Some are demand deposits held by households and firms. In addition, 'deposits' include standard looking loans that banks receive from people. For example, a person can bring money to a bank and buy a certificate of deposit. The objects on the liabilities side of the balance sheet require a stream of payments from the bank. For example, it has to pay interest on the certificates of deposit. Also, although it does not pay much explicit interest on demand deposits, those deposits do nevertheless cost the bank money. The bank has to hire people and rent office space in order to provide the various services that holders of demand deposit receive. So, 'deposits' are in practice a variety of different things. Let us ignore all the differences here and suppose that deposits simply cost 5 percent in interest.

The other term on the liability side of the bank's balance sheet is 'net worth'. This term is whatever it takes for assets and liabilities to be the same. So, in the example, in which assets are 100 and liabilities are 90, net worth is 10. Net worth is what is owned by the owners of the bank. When the bank is first set up, a group of owners gets together to do this. They put up some of their own money (say, \$10) and they go out and borrow some money (say, \$90) and then lend the money out (say, \$100). Over time the value of assets and the non-net worth component of liabilities fluctuate. This causes fluctations in net worth. When net worth goes negative, we say the bank is bankrupt.

With our balance sheet, we can now discuss two ways in which a rise in the interest rate could do damage to this bank. By 'damage', I mean drive net worth negative, and force the bank into bankruptcy and close.

The first way operates through the fact that a high interest rate causes a slowdown in the economy. To see how this works, suppose one of the loans on the asset side is to a cab driver. The cab driver used the money to buy a cab. With the economy in recession, the cab driver may be getting very little business. At some point, the driver may stop paying the \$1.50 on the bank loan. At this point the loan is said to be 'non-performing'. Note what this implies for the bank. The bank must make payments of $0.05 \times 90 = \$4.50$ on the liabilities side of its balance sheet. With some loans non-performing, the bank will only be earning $0.05 \times 70 = \$3.50$ on its asset side. The bank needs to pay out more money than it has. Strictly speaking, that non-performing loan

should be set to zero on the asset side, marking the assets down to \$70. With this mark-down, net worth is −\$20. The bank is bankrupt. In principle, this bank needs to shut down.

Here is a second way that a rise in the interest rate could do damage to a bank. The typical object on the asset side of the bank balance sheet has a long duration. For example, the loan to the cab driver might be a 10 year loan, for 5 percent per year. On the liability side of the balance sheet, financial instruments are typically of short duration. For example, certificates of deposit have durations of 6 months or a year. Because of this mismatch in duration, a rise in the interest rate increases the bank's obligations, without increasing its sources of income. In an extreme example, suppose the interest rate jumps from 5 to 10 percent, and this affects all the instruments on the liability side and none on the asset side. Then, the bank must pay \$9 per year in order to keep its \$90 of liabilities, while it only receives \$5 per year on its assets. In practice, the situation is not this dire. Some assets have variable interest rates, and some liabilities involve costs that do not move direcly with the interest rate (demand deposits, for example). Still, the example captures the basic flavor of the actual situation. Note how the rise in the interest rate puts the bank in a situation of not being able to pay its bills. Technically, it is bankrupt.[2]

In practice, banks don't suddenly go bankrupt when interest rates rise, as the example seems to suggest. For the reasons discussed above, central banks view private banks as 'special' and this is why they do things to keep banks going. You may wonder how this is possible. Surely, depositors would rush to the bank and take out their money as soon as they get wind that their bank is in bad shape. This would force the bank into bankruptcy. In practice, this does not happen, because their deposits are covered by deposit insurance. As a result, depositors don't really pay attention to or care about whether the bank is in good shape. This is why governments are heavily into banking regulation. Deposit insurance removes a key discipline device from banks - skittish depositors. Absent discipline from the market, government regulators are needed to ensure that banks make solid loans that are not too risky.

Of course, you may still wonder how a bankrupt bank continues to pay its bills. One way to do this is to run a type of Ponzi-scheme. Just before bills come due, the bank goes out and borrows money by increasing its liabilities. Of course, interest on this borrowed money must be paid too, but these interest payments occur in the future.

[2]I defined bankruptcy as a situation of negative net worth. You might think that net worth did not change in this example. Actually, that's not right. The market value of the bank's assets falls when the interest rate jumps, and a proper measurement of the balance sheet would be in terms of the market value of assets and liabilities.

At that time, additional money can be borrowed to pay that interest. Sometimes governments turn a blind eye to this type of behavior.[3] The disruptions to payments that might occur with the shut-down of a bank are avoided. In addition, the political drama that can go with bank shutdowns is avoided. For example, one reason the bank may have arrived at a technical bankruptcy is that it is making loans to firms that really don't deserve funding. They are continuing to be funded perhaps because the owners are politically well connected. Or, perhaps the loans are to firms that once were good business bets, but since then they have gone bad. Such a firm may continue to receive loans because of the cozy personal connections that have developed between officers of the bank and firm.[4] When faced with a bank like this that is in technical default, the government may prefer not to shut it down, because this avoids a lot of drama and because the government may not have the hard cash it would take to make good on deposit insurance and pay off the depositors. Moreover, the government can always comfort itself in thinking that somehow the situation will perhaps reverse itself on its own: perhaps the economy will take off and non-performing assets will start to perform.

Incidentally, one can see how it might be that if a lot of banks have negative net worth and are running Ponzi schemes, they would not have the funds necessary to finance loans for new investment activities. In this way, a banking system with really bad balance sheets can act as a drag on investment and, hence, aggregate economic activity. This type of argument has been used by the Economist magazine to explain the poor performance of the Japanese economy in the past decade. The idea is pursued in a Northwestern Phd thesis about Japan by Levon Barseghyan.

3. Why does E^e go up? There are three types of answers. They are closely related.

   (a) One ('First generation models') lays responsibility with bad government policy. This says that E^e goes up because the market correctly perceives that the government has been, or is about to, pursue policies that are inconsistent with the fixed exchange rate regime. Examples:

[3]The initial response to the US savings and loan crisis is an example.

[4]This problem has been referred to, colorfully, as the 'zombie lending problem'. It can occur in a banking system that has deposit insurance (so, the normal market discipline to ensure solid lending practices has been removed) and is not regulated carefully enough. See, for example, Caballero, Hoshi and Kashyap, 'Zombie Lending and Depressed Restructuring in Japan', November 30, 2004, http://gsbwww.uchicago.edu/fac/anil.kashyap/research/Zombiesnov302004.pdf.

i. Unemployment is high (i.e., Y is low), and the government just raises M and hopes that by some miracle the exchange rate does not devalue (we'll see later how the theory of imperfect asset substitutability can place a - false, unfortunately - veneer of respectability on this hope).

ii. The market may come to expect that M must rise in the future. This is thought to have played a role in the Asian currency crisis. The argument is that inadequate government regulation of the banking system over a period of years led the banks to make a lot of very bad loans.[5] People began to realize the extent of the bad loan problem and expected that to pay for this, the government would eventually resort to the printing press.[6] In our model, this manifests itself in the short run by a rise in E^e.[7] Notice that this story does not require that E^e jump in response to *actual* high money growth. In fact, high money growth was not observed prior to the crises in the Asian crisis countries. (Trouble is, high money growth was also not observed *after* these crises either.)

(b) The second reason ('Second generation models') lays responsibility with private expectations. Under this view, absent speculators'

[5]Good government regulation of the banking industry is very important. This is necessary to mitigate the bad ('moral hazard') effects of government guarantees of deposits in banks. The problem regulation must help solve arises because government guarantees remove an incentive from depositors to monitor the asset side of the bank balance sheet. For example, depositors don't really have to worry if their bank is making extremely risky loans because even if those loans go bad deposits are insured. In the absence of guarantees, of course, depositors would 'discipline' bankers who take excessive risk or are incompetent by withdrawing their funds. Because deposit guarantees eliminate this market discipline mechanism, guarantees have a tendency to give rise to excessive risk-taking in banks, and this is called 'moral hazard'. Government regulation of banks is designed to mitigate the moral hazard effects of deposit guarantees. (The story of why there are government deposit guarantees in the first place is a separate one. It has to do with a belief that in the absence of guarantees the banking system is 'fragile' and vulnerable to bank runs. But, this is another story...)

[6]What I mean by 'to pay for this' is the following. If a bank's net worth goes so far negative that the assets aren't enough to cover a bank's deposit liabilities, then the government must step in with its own money to make up the difference. If the government resorts to the printing press to come up with the money (as opposed to taxes), this means that M rises.

[7]This argument is laid out very carefully in Burnside, Eichenbaum and Rebelo, 'Understanding the Korean and Thai Currency Crises', 2000, Federal Reserve Bank of Chicago *Economic Perspectives*.

expectations of a devaluation, the government could and would pursue policies consistent with the exchange rate target. Speculators' expectations of a depreciation make a defense so costly, that the government has to give in to a depreciation.

i. An example is the 1995 French presidential election, when people came to believe that the government would devalue to help with the election. To defend the exchange rate required raising the interest rate above those in Germany by 3 percentage points. Although the government survived the attack in this case, it is easy to imagine (as the speculators imagined) that the government might have chosen to go with a devaluation rather than defend.

ii. A bad shock to aggregate demand produces the realization that the government will be in a situation where the conflict between domestic goals and the fixed exchange rate goal is be particularly sharp. Although the government could maintain the fixed exchange rate if market participants did not raise E^e, if E^e does go up the cost of a defense would be more than the government could bear. Knowing this, speculators might raise E^e at this time. If they do this, their expectations of a devaluation would be self-fulfilling. In this example, if market participants expected the government to stick to the fixed exchange rate and so they did not raise E^e, then this would be self-fulfilling too. The point is that in this scenario a currency crisis occurs as a result of private market expectations and not as a result of bad government policies.[8]

   There are several examples of this. One is the Asian crisis countries. In the years before the crisis in 1997, several things had happened to reduce aggregate demand in these countries. China devalued its currency, which reduced world demand for Asian crisis country goods, which had fixed the exchange rates to the dollar. The NAFTA agreement made Mexico a stronger competitor with the Asian countries for US markets. Also, the US dollar appreciated vis a vis the Yen, putting the Asian crisis countries at a disadvantage relative to Japan.

iii. A rise in foreign interest rates. If the central bank is to defend the exchange rate under these circumstances, then they must raise the interest rate. Markets may figure that the government does not have the stomach for this, and they raise E^e.

[8]Perhaps at a deeper level, one could still lay the blame on bad government policies. For example, suppose the conflict between domestic and exchange rate objectives is acute because the banking system's balance sheets are in poor condition. In this case, one might want to blame the risk of a currency crisis on bad policy after all if the poor condition of bank balance sheets is a result of inadequate regulation.

This may have effects which force the government to devalue in the end, even though, if markets had not raised E^e, the government would have had the resolve to raise the interest rate.

A possible example of this is Mexico in 1994. The US raised interest rates in that year and this put the Mexican central bank, which had a fixed exchange rate relative to the dollar, in a bind. The year 1994 was a presidential election year. So, markets expected the government to devalue. To try and convince the markets that it was serious about the exchange rate, the Mexican government took out loans in dollars. The idea was that, by making it expensive for the government if a devaluation occurred, this action would convince markets of the government's seriousness.

A second example is Europe in 1992. As a result of reunification in Germany, German interest rates rose. The rest of the countries in the EMS ('European Monetary System') had to raise their interest rates too, to preserve the exchange rate system in the EMS. Private markets decided in 1992 that a number of countries in the EMS just wouldn't have the stomach to do this, and raised E^e for these countries. Throughout 1992 these countries had to keep interest rates even higher than Germany's interest rates to defend the exchange rate. This was painful because unemployment was already high at this time. Markets understood how painful this was, and this is one reason they raised E^e in the first place. They figured that the pain would ultimately result in a devaluation. They were right in the case of Britain and Italy.

The attack went like this. On September 5-6, government officials solemnly proclaimed that the countries in the EMS were committed to the fixed exchange rates. September 8 - first attack, against Scandinavian countries. Finland gives up quickly and abandons the fixed exchange rate. Sweden defends, and raises rates first to 24 percent, then to 75 percent (at an annual rate). September 10-11 another attack. The Bank of Italy gives up, after sustaining huge foreign exchange losses. The lira is devalued 7% on September 13. September 16-17: the British pound comes under attack. The Bank of England gives up. Sweden increases interest rates to 500 percent! Ireland goes to 300 percent. France successfully defends. By the end of September, the crisis was over.[9]

[9]For a discussion of the European currency crisis of 1992, see Obstfeld, The Logic of Currency Crises (on his web site at Berkeley Econ department) or Blanchard, Macroeconomics, chapter 14. Obstfeld argued that the 1992 European crisis could not be explained

The Swedish crisis was particularly severe, and it is interesting to look at Sweden more closely. It's unemployment rate in the summer of 1992 was high, it had jumped from a 1982-91 average of 2.4 percent to 5.3 percent in 1992. The government deficit was in bad shape. Further recession would have made it a lot worse. The banking system was also thought to be in a troubled state. The market perceived that to defend the exchange rate would be quite costly, and this was one reason they raised E^e. One of the reasons that Sweden wanted to defend the exchange rate was that it wanted to prove to the other Europeans that it was ready for membership in the European Community (EC). When things happened that the market thought would make Swedish devaluation 'excusable' in the eyes of EC members, then the market's probability of a devaluation went up. So, when a vote occurred in Denmark that seemed to make European unification seem less likely in the near term, the idea was that the cost of abandoning the fixed exchange rate went down. The attack on Sweden became stronger. Sweden survived the September crisis. But, later, on November 19, they surrendered. (These observations are taken from Obstfeld's paper, cited in the footnote.)

Obstfeld (see the footnote for the reference) summarizes the situation nicely:

"Governments will balance the costs of defenses against the benefit of resisting realignment pressures; and often they will conclude that the pain is not worth the gain. Any economic event that raises the market's estimation of the government's susceptibility to pain, or that lowers the perceived gains from a successful parity defense, can trigger a speculative attack....If governments determine the extent of their resistance through cost-benefit analysis, however, self-fulfilling crises become likely in situations where economic distress already places the government under pressure. ... If markets expect a devaluation, for example, interest rates will rise, thus creating an incentive to devalue. Similarly, expectations of devaluation may be incorporated in wage demands, raising authorities' incentive to accommodate. These processes are circular: thus their timing is basically arbitrary and they can be brought into play by seemingly minor events."

(c) The third reason ('third generation models') is a combination of the first two. The idea is that economies become vulnerable to second generation crises if something happens that makes an interest rate defense of the currency costly. For example, if the banking

by 'first generation models'.

system and/or output are weak. The idea is that bad government policies have something to do with the crisis, but that they are not so bad that the crisis is absolutely inevitable.

The fact that expectations are so important is one reason central bankers are advised to be humorless and to not give any impression that they have human concerns. To see this, imagine a financial market participant wondering if the exchange rate will drop in the future. They will think about the central banker weighing the pain of raising the interest rate (high unemployment, disruptions) against the gain (staying in the fixed exchange rate regime) and they will believe that the 'pain' side will receive little weight. If they imagine the central banker cares only about the fixed exchange rate and is less moved by the plight of unemployed people, then such a financial market participate will not imagine the central banker caving in to a currency attack (i.e., rise in E^e). This will reduce the likelyhood of the attack occurring in the first place.

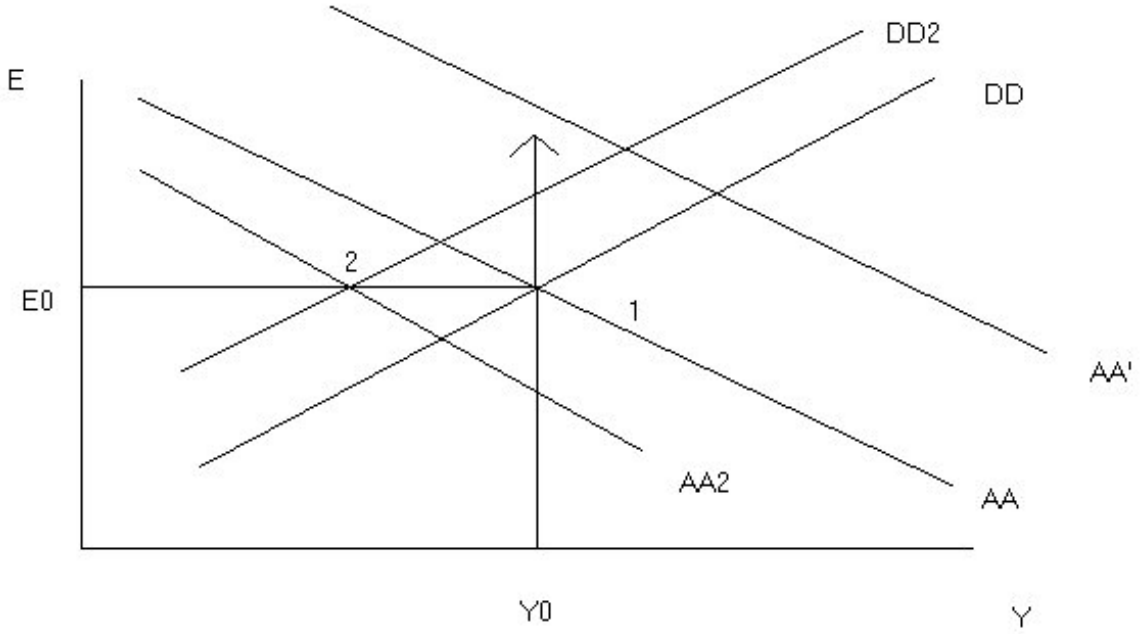

Figure 1: The Output Consequences of Defending the Fixed Exchange Rate, E0, when the Market Expectsa Devaluation and Aggregate Demand is a Decreasing Function of R.