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### Lecture #16: Currency Crisis

The focus of this class is on the currency crisis. This happens when private markets expect that the exchange rate will devalue in the future. We examine the situation of a central bank that attempts to preserve the fixed exchange rate under these circumstances.

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

(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,  $(E^e - E_0)/E_0$ . In practice, adjectives like 'crisis', 'attack', sometimes 'meltdown', are used to describe what happens after the market revises  $E^e$  up. Under the analysis of the standard model, it is hard to see why such extreme language is justified. The central bank that 'defends' the exchange rate,  $E_0$ , against a jump in  $E^e$  does nothing that has an effect on output or employment (for details of this analysis see figure 17-5 in the book).

(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, 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.<sup>1</sup> 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  $AA_2$ . 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. A Crash Course in Money and Banking.

The previous discussion brings out why defending a currency against a rise in  $E^e$  might be painful: by requiring a rise in  $R$ , it can hurt output and employment. To get a better feel for the potential disruptions associated with defending a fixed exchange rate in the face of a market expectation of a depreciation, it is useful to understand the balance sheets of the central bank and of the private banks. I then describe several features of banking systems: what makes them ‘healthy’ or ‘unhealthy’; the possibility of a crisis due to the maturity mismatch in bank balance sheets; and the multiple contraction in deposits that occurs with an open market sale of government assets by the central bank. Finally, I summarize the implications of this discussion for a central banker’s attitude towards open market actions which raise the rate of interest.

### (a) Balance Sheets.

A balance sheet breaks things down into assets and liabilities. Here is the balance sheet of the central bank:

#### Central Bank Balance Sheet

Assets	Liabilities
foreign reserves	deposits of local banks
domestic assets	

The ‘foreign reserves’ on the asset side of the balance sheet is composed of foreign currency (typically, the US dollar or some other highly tradeable currency), or foreign assets which can be quickly converted into currency (like US government debt). The domestic assets on the asset side of the balance sheet may be composed of the domestic government’s debt. On the liabilities

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<sup>1</sup>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.

side are deposits of local banks. The central bank, in effect, is the bank for the local banks. They maintain deposits with the central bank for two reasons. First, they may be required to do so by law. They may be required to hold a certain fraction of their liabilities (see below) in the form of deposits at the central bank as reserves. But, this is not the only the reason why banks hold deposits with central banks. For example, in Canada there are no reserve requirements. Yet, Canadian banks still hold deposits with the Bank of Canada, the Canadian central bank. The second reason banks hold deposits with the central bank is that this gives them an easy way to make payments among each other. When depositors at bank A write checks to depositors at bank B, then, bank B has to send ‘money’ to bank A. The way banks send money to each other in these type of circumstances is by sending them a check drawn on their reserves with the central bank. Thus, private banks hold reserves, or deposits, with the central bank for the same sort of reasons that private individuals hold checking deposits at private banks: to facilitate payments between them. The balance sheet of the entire private banking system put together has the following form:

Consolidated Balance Sheet of Private Banks

Assets	Liabilities
loans and other assets: \$800	demand deposits of households and businesses: \$900
reserves: \$200	net worth: \$100

On the asset side are two items: ‘loans and other assets’, which generate interest income for the bank; and ‘reserves’, which are the deposits of the bank with the central bank that were discussed in the previous paragraph. On the liabilities side there are two items. First, there are the demand deposits held by households and businesses. Second, there is ‘net worth’. This is what is ‘owed’ to the owners of the bank. Basically, it is whatever number is necessary, to ensure that the sum of liabilities equals the sum of assets. The way to think about net worth is this. When a group of people (‘owners’) get together to form a bank, they put up a bunch of their own money. This is used to purchase the building and other facilities of the bank (this is a part of the ‘other assets’). The net worth is also made available for making loans. Then, the owners open the door of the bank and invite people in to open demand deposits. The money that people bring to do this is made available, along with the net worth, for making loans and to hold in the form of reserves.

- (b) Healthy and Unhealthy banks.  
Healthy banks have a decent amount of net worth. Banks that

have made bad loans lose net worth. The way this happens is like this. On the loans side of the balance sheet, there are loans to individuals. Suppose a loan was made to finance a very shaky investment: a shopping center in the desert. If that shopping center does not attract any customers then the loan will go ‘bad’: the people who took it out will stop paying interest and principal on the debt. From the standpoint of the bank, the loan will in effect ‘disappear’. Suppose the loan was \$100. That \$100 will be eliminated from the bank’s assets if the company that borrowed the money folds. That will cause the loans and other assets to fall by \$100. Now, assets and liabilities must always sum to the same thing. What is it that changes on the liabilities side when a loan goes bad? It’s the net worth. A bad loan is ‘paid for’ out of net worth. A bank goes ‘bankrupt’ when its net worth goes negative. Sometimes, banking systems as a whole can get into situations where net worth is very close to zero. There are a couple of major examples. During the 1970s a lot of money flowed into Latin America in the form of loans. The money was fueled by ‘Petrodollars’. When oil prices rose in the 1970s the oil producing countries experienced a flood of dollars. They ‘saved’ these dollars in American banks, who then loaned them to Latin American banks. So, the Petrodollars flooded into Latin America. They were deposited with Latin American banks, which then loaned them out to finance various projects.<sup>2</sup> But, often those loans were not made wisely, and they went bad. This caused net worth to fall. In the 1980s this caused trouble, and a lot of the world’s money started to flow to the Asian ‘miracle’ countries instead. A similar thing then happened there. A lot of bad loans were made, and net worth was low. When net worth is *very* low, then the banking system is shaky, with a lot of banks on the verge of having to close their doors. When this happens, this is a big problem. It is not just a problem for the owners, who lose all the money they invested in the bank (the ‘net worth’). But, it is also a problem for the economy more generally. Banks are involved in nearly every transaction between individuals. They are the ones that handle the transfer of money between the individuals. When banks fail, these trans-

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<sup>2</sup>The ‘liabilities’ side of the private banking system banking sheet in these notes oversimplifies a little. Not only is there demand deposits and net worth. There are also things like certificates of deposit. These are liabilities of banks which do not provide transactions services, as demand deposits do. They do, however, pay reasonable interest. So, individuals make ‘loans’ to banks in two ways. One is via the demand deposits already discussed. The interest individuals receive for this is typically trivially small. Instead, they receive services, the ability to write and receive checks (‘transactions services’). The other is things like certificates of deposit, for which the primary payment is explicit interest.

action services are interrupted and this interferes with economic activity. Thus, the closure of a bank potentially has ramifications that extend far beyond the owners alone.

- (c) The maturity mismatch in bank balance sheets.

A shaky banking system is potentially one source of concern to central bankers. Another concern stems from another feature of banks. The assets and liabilities of a bank are characterized by something called a *maturity mismatch*. The deposit liabilities have maturity zero, in that the owners of those liabilities can come in at any time and request immediate payment in cash. On the asset side of the balance sheet, the only thing with zero maturity is reserves. Those are the same as cash. The deposits at the central bank can be transformed into cash with just a phone call.<sup>3</sup> The loans and other assets are not zero maturity, however. Those assets are hard to turn into cash. They are not very liquid at all. They are things like loans to grocery stores. Once that loan is made, it is hard to call it back before it is due. Even if the loan was a sound one, the first thing that happens to the money is that the grocery store pays it out to painters or builders or whatever. The money is initially simply gone and it cannot be gotten back, unless the grocery store just sells off all its assets and closes its doors, which is an extremely disruptive thing. Under the best of circumstances, a loan to a grocery store initially disappears, and then reappears later, hopefully, in the form of more revenues as business expands. But, until that 'later' occurs, it is very hard to get that loan money back.

Now, in this maturity mismatch feature of a banking system balance sheet there is hiding a potential 'crisis'. If everyone holding the bank's deposits liabilities came in and requested immediate cash, even a sound bank with a lot of net worth could not deliver. This fact can cause a panic among depositors. If anyone thought that everyone else was going to run on the bank (that is, go to the bank and request payment in cash for demand deposits), it would be in that person's interest to run too. If everyone thought in this

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<sup>3</sup>In the US, a bank would call its Federal Reserve bank, which is the local branch of the US banking system, called the Federal Reserve System. There are 12 Federal Reserve Banks distributed around the country. They store an enormous amount of cash in their vaults. A private bank can call its Federal Reserve district bank and request that it receive reserves in the form of cash. A heavily guarded armored truck then leaves the Federal Reserve bank to deliver the cash. Federal Reserve banks are extremely tightly guarded and fortified because they hold so much cash. There is special concern that banks will be requesting extra cash around the turn of the millenium. So, Reserve Banks are stockpiling huge amounts of cash right now, in preparation for this.

way, everyone would be running. In practice, this type of problem, which was important in the Great Depression, has greatly reduced in the US and other countries with deposit insurance. The possibility of a run still exists, however, because even with deposit insurance, a depositor may suffer long delays and other inconveniences in the event that a bank closes its doors.

- (d) The multiple contraction in deposits that occurs with a central bank open market sale of government debt.

Note how the banks' balance sheet shows that the bank backs 20% of its liabilities with reserves: \$200 in reserves for the \$1000 in liabilities (I'm using dollars here, just for the illustration). Suppose that this is the way banks want it. Suppose that, to meet legal reserve requirements, and needs for cash, banks want to hold an amount of reserves equal to 20% of their liabilities.

Suppose the banks *really* want to have 20% of their liabilities backed by reserves. Now, suppose the central bank executes an open market operation in which it sells \$100 of government securities for cash. This results in a drop of \$100 in the reserves of the banking system:

Consolidated Balance Sheet of Private Banks

Assets	Liabilities
loans and other assets: \$800	demand deposits of households and businesses: \$800
reserves: \$100	net worth: \$100

The open market operation has cut the reserves of the banking system in half. Assuming the banks want to keep 20% of their liabilities in the form of reserves, then the banking system has to cut its liabilities down to \$500. So, loans must be contracted by \$400, down to \$400. The banks can do this by calling in \$400 of loans. As people pay this into the bank with checks, the liabilities of the banks fall by \$400. After this, the balance sheet of the banks looks like this:

Consolidated Balance Sheet of Private Banks

Assets	Liabilities
loans and other assets: \$400	demand deposits of households and businesses: \$400
reserves: \$100	net worth: \$100

So, you get a contraction of the money supply (demand deposits) that is a multiple of the size of the open market operation. The details of how this happens when there are lots of banks are interesting, but not central to our current purposes (see a Money and Banking textbook for more details.)

The upshot is that a contractionary open market can involve economic dislocation if it is done abruptly, without leaving time for

banks to adjust. In this case, productive investment projects may need to be interrupted, to satisfy the bank's need to get the money back soon.

- (e) How a central banker feels about raising the rate of interest. The preceding discussion highlights the various concerns that a central banker may have about raising the interest rate, say to defend the currency. First, the higher interest rate may slow the economy down by reducing aggregate demand. Second, the reduction in aggregate demand may hurt the health of the banking system by driving a lot of companies into bankruptcy, and thereby making a lot of loans on bank balance sheets go bad. This is especially a problem if the banking system is already in a shaky position with very low net worth. It may lead to bankruptcies of banks, which in turn would disrupt payment services and, hence, economic activity. Third, the contractionary open market operation can cause a lot of disruptions if it forces banks to cut back on lending quickly. This can, for example, lead to investment projects, which require a continual flow of funding to keep going, to be interrupted.<sup>4</sup> Fourth, the reduction in net worth of the banks may help increase the probability of a banking crisis, as people worry about whether their money is in the bank.

3. A reconsideration of what happens with  $E^e$  jumps. Typically, the foreign exchange market for a small country is handled by the central bank directly. That is, when the central bank fixes the exchange rate, it promises to buy and sell foreign exchange at the stipulated exchange rate with all comers.

Immediately after everyone decides that  $E^e$  has gone up, people start to sell the local currency, in order to buy foreign assets. These now have a higher expected return than domestic assets. People go to the central bank with local currency, where they exchange it for dollars. Let's see how this works in slow motion.

Suppose a private citizen brings a check for \$100 of local currency into the central bank and exchanges that for dollars. What happens to the central bank's balance sheet?

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<sup>4</sup>Think of a bridge being built over a river. It needs constant funding for a year, until it reaches the other side. Then, cars will cross it and the tolls they pay will pay back the principal and interest on the loan. But, if funding of the bridge stops before the bridge is completed, then the whole project is a waste. It cannot generate any income until it is completely finished.

### Central Bank Balance Sheet

Assets	Liabilities
foreign reserves, -\$100	-\$100 reserves of banks

The check, drawn on a domestic bank, leads the central bank to mark down by \$100 the ‘checking account’ that the domestic bank has with the central bank. On the asset side, there is a drop by \$100 in the foreign reserves of the central bank. This is because, to hand over \$100 in US dollars to the private citizen, the central bank has to sell an equal number of US securities to get dollars.

The drop by \$100 in the reserves of local banks is part of the process whereby the central bank defends the exchange rate. That’s because that drop sets into motion a fall in the domestic money supply, as discussed above.

In practice, this fall in the reserves of banks can give rise to dislocations in the private economy, as banks stop making new loans, and start trying to reduce existing loans. Central banks don’t like to cause this sort of trouble, for all the reasons listed above. As a result, in practice, they might do an expansionary open market operation to replace the lost reserves of private banks. The expansionary open market operation, combined with the initial action described above, has the following net effect on the central bank’s balance sheet.

### Central Bank Balance Sheet

Assets	Liabilities
foreign reserves, -\$100	-\$100 reserves of banks
domestic government debt, +\$100	+\$100 reserves of banks (due to Open Market Oper

Evidently, if the central bank executes a \$100 open market purchase of domestic government debt, then the net effect on the money supply is zero.

If people continue to come to the central bank, exchanging domestic currency for foreign currency, then there will be a steady drain in the central bank’s foreign reserves. At some point, everyone realizes these reserves are getting low and may soon hit zero. Then the currency really would devalue. As more and more people come to realize this, they come in greater numbers to the central bank to get foreign currency in exchange for foreign currency. They do this because, if they do this before the devaluation, they can then buy back the local currency at a profit.<sup>5</sup> As soon as the central bank’s foreign reserves are gone, the

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<sup>5</sup>Suppose the number of pesos per dollar before the devaluation is 1. Suppose, too, that everyone expects the currency to depreciate to 2 pesos per dollar. Then, if you exchange 1 peso before the devaluation, and then get back into pesos afterward, you convert one



currency will devalue and this potentially fabulous profit opportunity disappears. So, now people have a strong incentive to 'run on the central bank': get to the central bank with local currency quickly, while there are still foreign reserves left. This run can turn into a stampeded, a panic.

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peso into 2.