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**An Introduction to Open Economy Macroeconomics,  
Currency Crises and the Asian Crisis**

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**Part 5. Money, Interest Rates and Exchange Rates. The Collapse of Fixed Exchange Rate Regimes. The Asian Currency Crisis of 1997.**

Money Supply and the Determination of the Interest Rate

The Foreign Exchange Rate Market

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In this part we will study a number of questions regarding the relation between monetary policy, interest rates and exchange rates and how currency crises occur. How does monetary policy affect interest rates? Why does a monetary expansion lead to lower interest rates? What is the effect of monetary policy on exchange rates? Why do some countries try to fix the level of their exchange rate while others let the value of their currency to be freely determined in the foreign exchange market? How does monetary policy differ in a regime of fixed and flexible exchange rates? After presenting the theory of currency crisis, we will analyze in detail the causes of the Asian currency crisis of 1997.

**Money Supply and the Determination of the Interest Rate.**

We consider first the equilibrium in the money market. The portfolio choice of individuals is to decide how much to invest in various financial assets. Suppose, for simplicity, that an investor has to decide how much to invest of her assets into money (cash balances that have a zero interest rate return) and how much to invest into interest bearing assets (short term Treasury bills).

Money (cash) balances have the disadvantage of not offering any nominal return (zero interest rate); they have the advantage that you can use them to do transactions (buy/sell goods). Short term bonds have the advantage that they earn interest; however, they have the disadvantage that they cannot be used to make transactions (you need money to buy goods and services). So, an investor will decide to allocate its portfolio between money and bonds considering the benefits and costs of both instruments.

So the demand for money will depend positively on the amount of transactions made (GDP,  $Y$ ) and negatively on the opportunity cost of holding money: this is the difference between the rates of return on currency and other assets (bonds):

Asset	Real Return	Nominal Return
Cash	-p	0
T-bill	r	$i = r + p$
Difference	$i = r + p$	$i = r + p$

where p is the inflation rate, i is the nominal interest rate and r is the real interest rate.

So the nominal demand for money is:

$$MD = P L(i, Y)$$

MD is the number of dollars demanded

P is the price of goods

L is the function relating how many \$ are demanded to Y and i.

The equation suggests that there are three main determinants of the nominal demand for money:

1. Interest rates. An increase in the interest rate will lead to a reduction in the demand for money because higher interest rates will lead investors to put less of their portfolio in money (that has a zero interest rate return) and more of their portfolio in interest rate bearing assets (Treasury bills).
2. Real income. An increase in the income of the investor will lead to an increase in the demand for money. In fact, if income is higher consumer will need to hold more cash balances to make transactions (buy goods and services).
2. The price level. An increase in the price level P will lead to a proportional increase in the nominal demand for money: in fact, if prices of all goods double, we need twice as much money to make the same amount of real transactions. Since the nominal money demand is proportional to the price level, we can write the real demand for money as the ratio between MD and the price level P. Then, the real demand for money depends only on the level of transactions Y and the opportunity cost of money (the nominal interest rate):

$$MD/P = L(Y, i^*)$$

We can represent the relation between the real demand for money and the interest rate on a graph where the interest rate is on the vertical axis and the real demand for money is on the horizontal axis (see [Figure 1](#)). The relation will be downward-sloping because a higher (lower) interest rate will cause a reduction (increase) in the demand for money.

Note that the position of the curve depends on the other variables that affect the demand for money. For example, an increase in the level of income Y will lead to an increase in the demand for money, at any level of the interest rate. So, an increase in Y leads to a rightward shift of the money demand curve. Therefore, in [Figure 1](#) changes in the interest rate are represented by a movement along the same money

demand curve while changes in the income are represented by shifts of the entire curve.

To find the equilibrium in the money market, we need now to determine the supply of money. The nominal supply of money is determined by the Fed that decides how much money should be in circulation. The supply of money by the Fed is defined as MS; the real value of this money supply is the nominal supply divided by the price level P, or MS/P.

Therefore, the equilibrium in the money market is given by:

$$MS/P = L(i, Y)$$

Real Money Supply = Real Money Demand

where MS is the amount of money/currency supplied by the Central Bank (through open market operations).

This equilibrium in the money market is represented in [Figure 2](#). Given the supply of money MS (and a given price level P), the real money supply (MS/P) is exogenously given. Given the demand for money curve, there is only one interest rate ( $i^*$ ) at which the money demand is equal to the money supply.

Note that, if the interest rate is above (below) the equilibrium one, the demand for money will be lower (higher) than the money supply and this will tend to decrease (increase) the interest rate until the equilibrium interest rate is restored.

To understand the economic mechanism that leads to this adjustment, note that the investor must decide how much to invest in money and how much to invest in bonds. Since the demand for money is a negative function of the interest rate, the demand for bonds will be a positive function of the interest rate: as interest rates become higher, the investor would like to put more of her wealth in bonds and less of her wealth in cash. This positive relation between the interest rate and the demand for bonds (BD) is represented in [Figure 3](#). In [Figure 3](#), we also show the supply of bonds: the total supply of bonds is equal to the total amount of bonds issued by the government that are now held by private investors. Note that the equilibrium interest rate that ensures that the demand for money is equal to the supply of money is the same as the interest rate at which the demand for bonds is equal to the supply of bonds. The total supply of bonds is determined by the bond issues of the government and the open market operations of the central bank (more on this below).

Consider now why an interest rate different from the equilibrium one will lead to changes that restore the equilibrium. Suppose that, for some reason the interest rate ( $i'$ ) is above the equilibrium one ( $i^*$ ). As [figure 4](#) shows, in this case the money demand will be lower than the money supply while the demand for bonds will be higher than the bonds supply. As agents want more bonds (less money) than what the market is supplying, they will try to get rid of their excess money balances to buy more bonds. The attempt to buy bonds by using the excess money balances will lead to an increase in the price of bonds and a reduction in their yield (return). As the interest rate starts to fall towards the equilibrium  $i^*$ , the demand for bonds will be reduced while the demand for money goes up. The process will continue, i.e. the price of bonds will rise and their yield fall until the point when the equilibrium interest rate is restored. At that point, money demand is equal to money supply and the bond demand is equal to the bonds supply.

We can consider next the effects of changes in monetary policy on the level of interest rates, i.e. how changes in the money supply affect short term interest rates. Consider first how the money supply is

increased. In general, the central bank changes the supply of money through open market purchases or sales of government bonds. Consider the following balance sheet of the central bank:

### Central Bank Balance Sheet

<b>Assets</b>		<b>Liabilities</b>
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<b>Treasury Bills held by the CB</b>	<b>300</b>	<b>Currency</b>
		<b>500</b>
<b>Foreign Exchange Reserves</b>	<b>200</b>	

The assets of the central banks are essentially two: Treasury Bills that can be used for open market operations; and foreign exchange reserves (in Yen, Marks and other currencies) that can be used for foreign exchange rate intervention. These foreign exchange reserves can take the form of central bank holdings of foreign cash and holdings of foreign countries government bonds. The liabilities of the central bank are equal to the total amount of currency in circulation. Money is, in fact, a liability of the government, a zero interest rate loan that the private sector makes to the public sector by being willing to hold cash.

Correspondingly, the balance sheet of the private sector is:

### Private Sector Balance Sheet

<b>Assets</b>		<b>Liabilities and Net Worth</b>
<b>Currency</b>	<b>500</b>	<b>Net Worth</b>
		<b>2000</b>
<b>Treasury Bills held by public</b>	<b>1200</b>	
<b>Foreign T-Bills held by public</b>	<b>300</b>	

Here, we assume that all private wealth is held only in three assets, money and domestic and foreign Treasury Bills; private agents do not have any liabilities so that their net worth is equal to their assets.

Now, consider the effects on the supply of money of an open market purchase by the central bank of 100b of domestic T-bills previously held by the public. Since the central bank buy these bonds from the public by printing more money, this open market purchase of T-bills leads to an increase in the money supply by 100b, from 500 to 600b:

### Central Bank Balance Sheet

<b>Assets</b>		<b>Liabilities</b>
<b>Treasury Bills</b>	<b>400</b>	<b>Currency</b>
		<b>600</b>
<b>Forex Reserves</b>	<b>200</b>	

### Private Sector Balance Sheet

Assets	Liabilities and Net Worth
<b>Currency 600</b>	<b>Net Worth 2000</b>
<b>Treasury Bills held by public 1100</b>	
<b>Foreign T-Bills held by public 300</b>	

Consider now the effects of this open market operation on the money and bond markets (see [Figure 5](#)): the supply of money increases (as the MS curve shifts to the right) while the supply of bonds available to the public decreases (as the BS curve shifts to the left). At the initial interest rate, the open market purchase of bonds leads to an increase in the money supply (from 500 to 600) and a reduction in the supply of T-bills available to the private sector (1200 to 1100).

Given the initial interest rate  $i^*$ , the increase in the money supply implies that now the money supply is greater than the money demand: agents were happy with their initial holdings of cash and are now forced to hold more cash than they desire. Conversely, in the bond market, the reduction in the supply of T-bills implies that the demand for bonds is now greater than its supply. Since private agents have now more cash than they desire and less bonds than they desire, they try to get rid of the excess money balances by buying more T-bills. Their attempt to buy bonds in exchange for cash leads to an increase in the price of bonds and a fall in the interest rate. The interest rate fall, in turn, reduces the excess supply of money and the excess supply of bonds.

Since the supply of money and bonds is exogenously given, the attempt of agents to get rid of excess cash in exchange of more bonds cannot succeed: in equilibrium the greater amount of cash has to be willingly held by agents and the lower supply of bonds has to be willingly held by agents. Then, the interest rate has to fall so that the demand for money is increased and demand for bonds is decreased. This process has to continue up to the point in which the interest rate has fallen enough so that the demand of money is equal to the higher money supply while the bond demand is equal to the lower bond supply. Therefore, an increase in the money supply through an open market purchase of T-bills leads to a reduction in the equilibrium interest rate.

The previous example clarifies how the central bank affects the level of short term interest rate via changes in the money supply. When the Fed wants to tighten (loosen) monetary policy, it will perform an open market sale (purchase) of government bonds that will lead to a reduction (increase) in the money supply and an equilibrium increase (fall) in the short term interest rate.

### The Foreign Exchange Rate Market

We will consider next the determination of the exchange rate in the foreign exchange market and the difference between a regime **of fixed exchange rates** and a regime of **flexible exchange rates**. Consider the case of a small open economy such as Mexico. In the exchange rate market, there are some economic agents who demand US Dollars (i.e. they sell/supply Mexican Pesos) and others who sell/supply Dollars in exchange for Pesos.

The demand for US Dollars (supply of Pesos) in the exchange market comes from different types of agents: Mexican importers of U.S. goods and services who have to pay in Dollars for their imports; U.S.

exporters of American goods in Mexico who have been paid in Pesos and want to convert their Pesos into U.S. Dollars; and investors who are selling Pesos and buying Dollars because they want to buy U.S. assets (bonds, equity, and other U.S. assets). This demand for U.S. Dollars is represented in [Figure 6](#) by the curve  $D\$$ . The curve shows that, as the exchange rate of Mexico (Pesos per Dollar) depreciates the demand for U.S. dollars is reduced. In fact, if the Peso depreciates, U.S. goods become more expensive and Mexican imports of U.S. goods are reduced; since imports of U.S. goods have to be paid in U.S. Dollars, a depreciation of the Pesos reduces the demand for Dollars as the reduced imports by Mexico of American goods leads to a reduced demand for Dollars.

On the other side of the exchange rate markets there are agents who are selling (supplying) U.S. Dollars in exchange of Mexican Pesos. These agents are: Mexican exporters of goods to the U.S. who have been paid in U.S. Dollars and need to convert them in Pesos, U.S. importers of Mexican goods who need Pesos if they need to pay in Pesos for their imports; and investors who are buying Pesos in order to buy Mexican securities (bonds, stock and any other asset). This supply of U.S. Dollars (demand of Pesos) is represented in [Figure 6](#) by the curve  $S\$$ . The curve shows that, as the exchange rate of Mexico (Pesos per Dollar) depreciates the supply of U.S. dollars is increased. In fact, if the Peso depreciates, Mexican goods become cheaper in international markets and Mexican exports to the U.S. goods are increased; since Mexican exporters are paid in U.S. Dollars, a depreciation of the Pesos increases the supply of Dollars as the greater exports of Mexican goods lead to larger Dollar receipts that need to be converted into Pesos.

Consider now the equilibrium in the exchange rate market: there is going to be an exchange rate  $S$  (Pesos per Dollar) at which the demand for Dollars (supply of Pesos) is equal to the supply of Dollars (demand for Pesos): this equilibrium exchange rate is  $S^*$  in [Figure 6](#). [Figure 7](#) shows that, if the initial Peso/Dollar exchange rate is depreciated relative to its equilibrium value (i.e.  $S' > S^*$ ), the supply of Dollars will be greater than the demand for Dollars (as Mexican exports are higher and their imports lower) and this will tend to appreciate the Peso relative to the \$. In the figure  $S$  will fall, meaning that the Peso will appreciate until the equilibrium exchange rate  $S^*$  is restored. The reverse will happen if the initial  $S$  is below (appreciated relative to) the equilibrium one.

When a country has a regime of "**flexible exchange rates**", it will allow the demand and supply of foreign currency in the exchange rate market to determine the equilibrium value of the exchange rate. So the exchange rate is market determined and its value changes at every moment in time depending on the demand and supply of currency in the market.

Some countries, instead, do not allow the market to determine the value of their currency. Instead they "peg" the value of the foreign exchange rate to a fixed parity, a certain amount of Pesos per Dollar. In this case, we say that a country has a regime of "**fixed exchange rates**". In order to maintain a fixed exchange rate, a country cannot just announce a fixed parity: it must also commit to defend that parity by being willing to buy (sell) foreign reserves whenever the market demand for foreign currency is greater (smaller) than the supply of foreign currency.

To understand how fixed and flexible exchange rate regimes work suppose that, initially, the exchange rate is equal to a value  $S^*$  such that the demand and supply of foreign currency are equal (see [Figure 8](#)). But, then, some shock occurs that leads to an increase in the demand for foreign currency: for example, a boom in income in the domestic economy leads to an increase in imports that have to be paid in foreign currency.

Such a shock is represented in [Figure 8](#) by a rightward shift in the demand for foreign currency. If a country has a regime of flexible exchange rates, it will allow the increase in the demand of foreign currency to cause a depreciation of the domestic currency: the equilibrium exchange rate depreciates

from  $S^*$  to the new equilibrium value  $S'$ . Conversely, suppose that the country has a regime of fixed exchange rates: in this case the country is committed to defend the parity  $S^*$ : it will not allow the currency to depreciate to  $S'$ .

How can a country avoid such a depreciation of its currency? Note that at the initial fixed exchange rate  $S^*$ , after the shock has occurred the market demand for foreign exchange is greater than the market supply ( $D\$' > S\$$ ). Therefore, in order to prevent a depreciation of the domestic currency, the central bank of the country has to provide to the market an amount of foreign exchange reserves equal to the difference between the market demand and the market supply of Dollars. In other terms, the central bank has to sell foreign exchange reserves that it was holding among its assets in order to prevent the currency depreciation.

In technical terms, the central bank **intervenes** in the foreign exchange rate market by selling foreign currency. Therefore, a country can defend a fixed exchange rate parity that differs from the equilibrium exchange rate (that would hold under flexible rates) only as long as it has a sufficient amount of foreign exchange reserves to satisfy the market excess demand for the foreign currency. If the country runs out of foreign exchange reserves, the fixed parity becomes unsustainable and the central bank will be forced to give up the defense of the currency: the exchange rate will depreciate to its flexible rate value  $S'$ .

Note also **that foreign exchange rate intervention affects the money supply** of the country under consideration. In fact, when the central bank intervenes to defend its parity, it is selling foreign exchange currency to investors in the market; in exchange of its sale of foreign currency the central bank receives domestic currency that is therefore taken out of circulation: investors pay with domestic currency their purchase of foreign currency from the central bank. In this sense, foreign exchange intervention taking the form of a sale of foreign reserves has an effect on the money supply that is identical to an open market sale of government securities; in both cases, the money supply is reduced. To see the effects of foreign exchange intervention on the money supply, consider the following example. Suppose the central bank intervenes in the foreign exchange rate market by selling 50b worth of foreign reserves. Before, the intervention, the balance sheet of the private sector and central bank were:

#### **Private Sector Balance Sheet**

<b>Assets</b>	<b>Liabilities and Net Worth</b>
<b>Currency 600</b>	<b>Net Worth 2000</b>
<b>Treasury Bills held by public 1100</b>	
<b>Foreign assets held by public 300</b>	

#### **Central Bank Balance Sheet**

<b>Assets</b>	<b>Liabilities</b>
<b>Treasury Bills 400</b>	<b>Currency 600</b>
<b>Forex Reserves 200</b>	

After the 50b sale of foreign exchange represented by the forex intervention:

### Private Sector Balance Sheet

Assets	Liabilities and Net Worth
Currency 550	Net Worth 2000
Treasury Bills held by public 1100	
Foreign assets held by public 350	

### Central Bank Balance Sheet

Assets	Liabilities
Treasury Bills 400	Currency 550
Forex Reserves 150	

Therefore, foreign exchange rate intervention taking the form of a sale of foreign reserves leads to a reduction in the money supply. Conversely, foreign exchange rate intervention taking the form of a purchase of foreign reserves leads to an increase in the money supply.

### The Effects of Open Market Operations Under Flexible and Fixed Exchange Rate Regimes

We discussed above in the section on the money market equilibrium how open market purchases and sales of domestic government bonds affect the money supply and the interest rate of an economy. Open market operations are the standard way in which a central bank controls the money supply and interest rates. We should consider now the effects of such open market operations when the economy is open. We will show that open market operations have very different effects under **flexible** and **fixed** exchange rate regimes.

Consider first the effect of an open market purchase of government bonds under flexible exchange rates. Under flexible rates, the central bank does not intervene to defend its currency when market pressures lead to its weakening. Therefore, an open market purchase of domestic bonds will lead to an increase of the money supply. In turn, this increase in the money supply will cause a reduction of the domestic interest rate (see [Figure 5](#) above). What will be the effect of this monetary expansion on the exchange rate? The exchange rate will depreciate: in fact, as interest rate at home are now lower than before, investors will want to reduce their holding of domestic bonds and increase their holding of foreign bonds that are now relatively more attractive in terms of their return. Therefore, domestic investors will try to sell domestic bonds, buy foreign currency and buy foreign bonds. The attempt to sell domestic currency in order to buy foreign bonds will, in turn, cause a **depreciation** of the domestic currency.

The effects of the open market purchase of bonds (say 50b) on the money supply under flexible exchange rate will be identical to the one obtained in a closed economy: the money supply will increase and interest rates will fall. As an example, before the open market purchase, the central bank balance

sheet was:

### Central Bank Balance Sheet

Assets	Liabilities
Treasury Bills held by the CB 300	Currency 500
Foreign Exchange Reserves 200	

After the open market operation:

### Central Bank Balance Sheet

Assets	Liabilities
Treasury Bills held by the CB 350	Currency 550
Foreign Exchange Reserves 200	

The increase in the money supply and reduction in the interest rate will lead to a depreciation of the domestic currency but since the central bank does not defend the current parity under flexible exchange rates, no foreign reserve intervention will occur and foreign reserves will remain the same as before: then, the exchange rate will depreciate.

Consider next the effects of the same open market purchase of domestic bonds under fixed exchange rates. We will show that, under a regime of fixed exchange rates, any attempt by the central bank to increase the money supply via an open market operation is not going to be successful: the central bank is not going to be able to change the money supply. The reason is that, if the exchange rate is fixed, the equilibrium level of the money supply is determined endogenously and cannot be affected by exogenous central bank open market operations. Let us see why. We know from Part2 that, under conditions of perfect capital mobility, the uncovered interest rate parity condition holds, i.e. the domestic interest rate is equal to the foreign interest rate plus the expected depreciation of the domestic currency or:

$$i = i^* + dS/S$$

Now, under fixed exchange rate, the exchange is not allowed to change: therefore the expected depreciation of the domestic currency ( $dS/S$ ) must be, by definition, equal to zero. This also means that, under fixed exchange rate, the nominal interest rate of a small open economy must always be equal to the world interest rate ( $i=i^*$ ): if it was lower, no one would hold domestic bonds. Now consider how this equality of domestic and world interest rates affects the equilibrium in the domestic money market. Assume that, in the short-run framework here considered, the domestic output ( $Y$ ) is constant and the domestic price level ( $P$ ) is constant. The equilibrium in the money market implies that real money demand must be equal to real money supply:

$$M/P = L(Y, i) = L(Y, i^*)$$

or:

$$M = P L(Y, i^*)$$

Since  $P$ ,  $Y$  and  $i^*$  are exogenously given under fixed exchange rates, the equilibrium value of the money supply  $M$  is determined residually and the central bank has no control over it: given the domestic price level, the domestic output and the world interest rate, there is only one value of the money supply such that the money market is in equilibrium. Therefore, open market operations cannot affect the level of the money supply under fixed exchange rates.

Suppose that the central bank tries to increase the money supply through an open market operation, in spite of this endogeneity of the money supply under fixed rates. Why would this attempt to increase  $M$  fail under fixed rates? The reason is simple: any attempt to increase the money supply through an open market operation in domestic bonds will cause a loss of foreign exchange reserves that will bring back the money supply to its original level.

Why will this loss of reserves occur? Consider the mechanics of an open market operation under fixed exchange rates. In the first moment, the open market purchase of bonds will lead to an increase in the money supply (as in the flex rate case) and the money supply will increase from 500 to 550:

### Central Bank Balance Sheet

#### Assets

#### Liabilities

**Treasury Bills held by the CB 350**

**Currency 550**

**Foreign Exchange Reserves 200**

However, as soon as the open market operation is conducted, the increase in the money supply would tend to reduce the domestic interest rate below the world interest rate ( $i < i^*$ ). As this reduction in domestic interest rate starts to occur, all investors will try to sell the lower yielding domestic bonds in order to buy the now higher yielding foreign bonds. In order to buy foreign bonds, agents have first to buy foreign currency. So these incipient capital outflows will put pressure on the domestic exchange rate. If the exchange rate regime were flexible, these incipient capital outflows would cause a devaluation of the currency.

However, we are now under fixed exchange rates and the central bank is committed to defend the domestic parity. As the domestic agents try to get rid of their domestic money in order to buy foreign currency and foreign assets, they will sell the domestic currency to the central bank and purchase the foreign currency from the central bank. Since the central bank is committed to the fixed exchange rate, it is forced to intervene and sell and sell to the public as much foreign reserves as they want. So the central bank will lose foreign exchange reserves and this intervention will reduce the domestic money supply.

Note that the loss of foreign reserves must be equal to the initial open market operation that has led to the excess supply of money and the downward pressure on domestic interest rates. In fact, only when the loss of reserves equals the initial open market purchase of bonds, the money supply will go back to its initial level, the domestic interest rate will rise back to a level equal to the world rate and the pressure to lose further reserves will be eliminated. So, after this combined open market purchase and ensuing loss of reserves has occurred, the money supply will go back to the value (500) it had before the central bank had tried to change the money supply:

### **Central Bank Balance Sheet**

<b>Assets</b>	<b>Liabilities</b>
<b>Treasury Bills held by the CB 350</b>	<b>Currency 500</b>
<b>Foreign Exchange Reserves 150</b>	

The only effect of this failed attempt to increase the money supply is that the money supply is the same as before while the asset side of the balance sheet of the central bank has changed: now the central bank has more domestic bonds in its asset portfolio and less foreign reserves.

The implication of the above discussion is as follows: under fixed exchange rates and perfect capital mobility, the central bank has no control on the money supply. Under fixed exchange rate there is no monetary autonomy: the central bank has no independent power to set the money supply and the domestic interest rate. Any attempt to increase the money supply through an open market operation will lead to an equal and offsetting loss of foreign exchange reserves with no overall effect on the money supply.

Note that an extreme form of a fixed exchange rate regime is a "currency board" such as the one instituted by Argentina in 1991. As we will discuss in more detail below, in the case of the currency board, the commitment to defend the fixed parity is reinforced by a constitutional law and by automatic monetary intervention rules that guarantee the stability of the exchange rate. The reasons why countries decide to have fixed exchange rates are several but can be summarized as follows. First, if exchange rate depreciation is an exogenous cause of domestic inflation (as the price of imported goods goes up with a depreciation), a country with a fixed exchange rate will be able to achieve an inflation rate that is close to the world inflation rate. In fact, if the PPP holds, domestic inflation is equal to foreign inflation plus the percentage depreciation of the domestic currency. If the currency depreciation rate is zero, as in fixed rates, domestic inflation will equal foreign inflation.

Second, countries with large budget deficits might be tempted to finance their budget deficit by printing money rather than by issuing bonds. In turn, this monetary financing of the deficits causes a vicious circle of high inflation and currency depreciation. Fixed exchange rates then force the country to avoid devaluations and high inflation rates. But the only way to avoid eventual high inflation and currency devaluation is to stop financing budget deficits by printing money (seigniorage). So fixed exchange rate prevent countries from creating seigniorage and inflation taxes: budget deficits will have to be financed with bonds bought by the private sector because a central bank financing of the deficit will cause a persistent reduction of the foreign reserves of the central bank. Moreover, under fixed rates, this lack of inflation revenues might eventually force the government to actually reduce the budget deficit through increases in taxes and cuts in government spending. Therefore, the monetary discipline provided by fixed exchange rates might eventually also lead to fiscal discipline.

### **The Joint Determination of the Interest Rate and Exchange Rate in the Money and Exchange Rate Markets under Flexible Exchange Rates.**

Let us consider now in more detail the equilibrium in the money market and in the foreign exchange market under flexible exchange rates. In the money market, the equilibrium condition is the equality between real money supply and real money demand:

$$MS/P = L(Y, i) \quad (1)$$

Equation (1) is represented graphically in Figure 2.

The equilibrium in the exchange rate market is given by the uncovered interest rate parity condition discussed in [Part 2](#):

$$i = i^* + \{[E_t(S_{t+1})/ S_t]-1\} \quad (2)$$

Equation (2) implies that the return on domestic bonds must be equal to the total return on holding foreign bonds; in turn, the latter is the sum of the return on foreign bonds plus the expected percentage rate of depreciation (appreciation) of the domestic currency. For example, if the foreign interest rate is 5% and investors expect a 2% depreciation of the domestic currency, the total return to holding foreign bonds will be 7%, equal to the sum of 5% plus the 2% exchange rate capital gain deriving from holding a more appreciated currency. We can represent the right hand side of equation (2) in [Figure 9](#) where the horizontal axis is the overall return on foreign assets and the vertical axis is current level of the exchange rate ( $S_t$ ). The curve is downward sloping for the following reason. Take today's expectation of tomorrow's exchange rate  $E_t(S_{t+1})/$  as given, say equal to 1. Then, if today's exchange rate is also equal to 1, the total return on the foreign asset is equal to  $i^*$ , say 5%. Suppose now that the expected future exchange rate remains equal to 1 while today's spot exchange rate is now more appreciated than before, say equal to 0.95; then, the expected depreciation of the domestic currency is equal to 5.2%  $((1-0.95)/0.95)$  and the overall return on the foreign asset is 10.2%  $(=5\% + 5.2\%)$ . If the current spot exchange rate is 0.9 and the expected future spot is still 1, the expected depreciation is equal to 11%  $((1-0.9)/0.9)$  and the overall return on the foreign assets is now equal to 16%  $(=5\%+11\%)$ . In general the relation between the overall return on the foreign asset and the current exchange rate is negative (as in [Figure 9](#)) because, for a given expected future exchange rate, a more appreciated current spot exchange rate (a smaller  $S$ ) implies a larger expected depreciation and therefore a larger return on the foreign asset.

Equation (2) also tells us that if we know the value of the domestic and foreign interest rates and the value of the expected future exchange rate, we can derive the equilibrium current period spot exchange rate. To find this equilibrium exchange rate we have to put together equation (1) (represented by Figure 2) that determines the domestic interest rate with equation (2) that is presented in Figure 9. The combination of these two equilibria is presented in [Figure 10](#). The bottom part of Figure 10 presents the determination on the nominal interest rate in the money market (this is Figure 2 rotated to the right in Figure 10): given the exogenous real money supply, the real money demand curve determines the domestic interest rate at which money demand is equal to money supply.

Once we have found the equilibrium domestic interest rate, we can use equation (2) represented in the top part of Figure 10 to find the equilibrium spot exchange rate. The equilibrium spot rate  $S^*$  is the value of today's exchange rate at which the return on domestic assets is equal to the overall return on foreign assets. Given equation (2), once we know  $i$ ,  $i^*$  and the expected future spot exchange rate ( $E_t(S_{t+1})$ ), there is only one value of  $S_t$  such that the return on domestic assets is equal to the return on foreign assets. For example, suppose that, given the money supply and money demand, the equilibrium domestic interest rate is 10.2%. Then the value of  $S_t$  at which the return on domestic assets (10.2%) is equal to the overall return on foreign assets is equal to 0.95. This equilibrium value of  $S_t$  is obtained by finding the value of  $S$  at which the downward sloping curve  $i^*+\{[E_t(S_{t+1})/ S_t]-1\}$  meets the vertical line representing the equilibrium domestic interest rate, as shown in Figure 10.

We can then discuss the effects on the exchange rate of a change in domestic monetary policy. Suppose

that, as shown in [Figure 11](#), the domestic money supply is increased (via an open market operation) from  $MS_1$  to  $MS_2$ . Then, the equilibrium in the money market requires a fall in the equilibrium domestic interest rate from the original  $i_1$  (=10.2%) to  $i_2$  (say 8.0% now). The Figure 11 shows that this monetary policy shock should cause a depreciation of the domestic currency from the original  $S_1$  (the original 0.95) to  $S_2$  (in this case equal to 0.97). In fact, at the original (pre-shock) level of the exchange, the fall in the domestic interest rate lead initially to a lower return on domestic asset relative to foreign assets. The ensuing capital outflow causes the depreciation of the domestic currency. In summary, a monetary expansion that leads to a reduction in domestic interest rates causes a depreciation of the domestic currency.

We can consider next the effects on the exchange rate of a number of other economic shocks. Suppose that, for some reason, there is a shock that leads investors to expect that the domestic exchange rate will depreciate in the future. To simplify things, assume that, before this shock, agents were not expecting any depreciation of the exchange rate in the future, i.e.  $E_t(S_{t+1}) = S_t$ , and that both the actual and expected exchange rates were equal to 1. However, after the shock occurs we have  $E_t(S_{t+1}) = 1.07 > S_t = 1$  so that investors are now expecting a 7% depreciation of the domestic currency. The effects of this change in expectations are presented in [Figure 12](#). The shock to expectations shifts to the right the curve representing the overall return to foreign bonds: in fact, for any given current exchange rate, the change in expectations increases the total return to foreign assets. Before the shock we had  $E_t(S_{t+1}) = S_t$ ; therefore, the domestic interest rate was equal to the foreign interest rate ( $i = i^*$ ), say 5% as in the Figure. The figure shows that the change in expectations about the future exchange rate from 1 to 1.07 leads to an immediate depreciation of the current domestic exchange rate at time  $t$ , from 1 to 1.07, i.e. the change in expectations leads to an immediate depreciation of the domestic currency. The reason why a change in expectations about future exchange rates leads to an immediate depreciation of the domestic currency is clear: when the change in expectations occurs, given the initial exchange rate  $S_t$  still equal to 1, the expected return on foreign assets goes up from 5% to 12% (=5% plus the expected depreciation of 7%). As foreign assets are now expected to have a higher return than domestic assets (who are earning only 5%), agents dump the domestic asset and currency in order to buy the higher yielding foreign assets. This capital outflow leads to an instantaneous depreciation of the domestic currency by 7%. Only when the current exchange rate falls from 1 to 1.07, the equilibrium in the exchange rate market is restored. In fact, in the new equilibrium we have  $E_t(S_{t+1}) = S_t = 1.07$  and  $i = i^* = 5\%$ .

The above example shows the importance of expectations for the determination of exchange rates. Changes in expectations can have very rapid effect on the level of exchange rates. Moreover, these changes in expectations may be the result not only of new information about the fundamental future value of the domestic exchange rate. They can also be a result of pure speculative factors: a change in the market mood or investors' beliefs about the future value of a currency that is not based on true fundamental variables (such as change in current and future economic conditions and interest rates). Exchange rates can then move for pure speculative reasons: as in the example above, if the market starts to expect a future devaluation of the domestic currency for whatever reason (rational or not), such a change in expectations will lead immediately to a self-fulfilling depreciation of the domestic currency.

Changes in other variables can also affect the domestic exchange rate. For example, an increase at time  $t$  in the foreign interest rate  $i^*$  has an effect on the domestic exchange rate that is identical to that of a change in expectations described above. Initially, the increase in the foreign interest rate leads to an increase in the expected return on foreign assets above the return on domestic assets (a shift to the right of the curve representing the expected return on foreign assets). This, in turn leads domestic investors to dump domestic assets and currency; this capital outflow causes an immediate depreciation of the

domestic currency. In the new equilibrium the domestic currency depreciates by a percentage amount equal to the increase in the foreign interest rate, i.e. if the foreign exchange interest rate goes from 5% to 8%, the domestic currency depreciates by 3%. This effect of a higher foreign interest rate is represented graphically in [Figure 13](#).

### Effect of Economic Shocks on the Exchange Rate Under Fixed Exchange Rate Regimes

As discussed above, under a regime of flexible exchange rates economic shocks such as a change in foreign interest rates or an exogenous change in expectations about future exchange rates lead to a devaluation of the domestic currency. What will be the effect of such shocks in a regime of fixed exchange rates?

In the discussion above on fixed exchange rates we argued that, in a regime of fixed exchange rates, the central bank has no autonomous power to arbitrarily change the level of the money supply. That, however, does not mean that the domestic money supply is always constant under fixed rates. In fact, shocks to the variables that determine the demand for money (i.e. shocks to the domestic price level, the domestic output and the world interest rate) will, in equilibrium, force a change in the level of the money supply. The equilibrium in the money market under fixed rates is given by:

$$M = P L(Y, i^*)$$

For example, suppose that starting from an initial equilibrium, the foreign interest rate goes up. The domestic interest rate will also increase and this will lead to a reduction of money demand. To restore the equilibrium the money supply must also fall. How will this reduction of the money supply be achieved? When the foreign interest rate goes up, the domestic interest rate is initially unchanged: so agents try to sell domestic bonds and buy foreign currency in order to buy the higher yielding foreign bonds. In order to prevent the currency depreciation that this capital outflow would cause under flex rates, the central bank intervenes and sells foreign currency. In turn, this intervention reduces the money supply and leads to an increase in the domestic interest rate up to the new higher world interest rate. At that point, the loss of reserves stops, the money supply is lower than before (as the forex intervention took domestic liquidity out of circulation) and the domestic interest rate has risen to the level of the world interest rates.

Alternatively, the central bank could achieve the same reduction in the equilibrium level of the money supply necessary to restore the equilibrium in the money market via an open market sale of domestic government bonds rather than the above sale of foreign reserves. Both actions lead to the same required result: the money supply is reduced and the domestic interest rate goes up to the level of the world rate. In this example, open market operations are effective in changing the money supply but this does not mean that the monetary authority had any autonomous power to change the money supply. Quite to the contrary, the initial increase in the world interest rate **forces** the central bank to engineer an equilibrium reduction in the domestic money supply: this reduction can be achieved either through a loss of foreign reserves or alternatively, if the central bank wants to avoid the reserve loss, through a required open market operation that takes liquidity out of the market and pushes the domestic interest rate up to the new world interest rate level. In this example, open market operations do affect the money supply under fixed rates but not because the central bank has an autonomous power to change the money supply: the central bank has to **passively** intervene to adjust the money supply to the level required by higher world interest rate.

The effects of the increase in the foreign interest rate under fixed rates are presented graphically in [Figure 14](#). Initially, the increase in the foreign interest rate (say from 5% to 8%) leads to an increase in the total expected return on foreign assets, a shift to the right of the curve representing foreign returns. Under flexible exchange rates, this change would lead to a 3% depreciation of the domestic currency from 1 to 1.03. Under fixed rates, this depreciation has to be prevented and the only way to do that is to have an increase in the domestic interest rate from 5% to 8% to match the higher world interest rate. This increase in the domestic interest rate is obtained by an endogenous reduction in the domestic money supply from MS1 to MS2. How will this contraction in the money supply occur? Either the central bank intervenes to defend the currency when the foreign interest rate goes up and this intervention leads to a fall in the money supply; or, equivalently, the central bank performs an open market sale of government bonds that reduces the liquidity in the economy. Both actions have the effect of reducing the domestic money supply and increase the domestic interest rate to the higher world interest rate.

Another shock that might occur in a regime of fixed exchange rates is a change in expectations that leads to **an expected future depreciation of a fixed exchange rate**. How should monetary authorities that are trying to defend a fixed parity react to a change in investors' sentiments about the credibility of the country commitment to fixed exchange rates? To understand this case, one must first note that, under fixed exchange rates, the exchange rate parity is constant. So, in normal times when the commitment to a fixed parity is credible the future exchange rate is expected to remain equal to the current fixed parity as agents believe that the parity will not be changed.

However, being in a regime of fixed exchange rates does not mean that the fixed parity will never be changed. For example, if the central bank runs out of reserves to defend the currency, a devaluation might occur at some point. This means that a fixed parity may not be fully credible in the sense that there is a positive probability that the future exchange rate will be different from the current one if a devaluation occurs. In other terms, in spite of the current fixity of the exchange rate, changes in the expectations about the future value of the exchange rate might occur even in a regime of fixed exchange rates (that is not fully credible). Such changes in expectations may be due to good reasons such as changes in fundamental variables (high domestic inflation, large budget deficits, political risks and so on) or might, at times, also be caused by "irrational" changes in the investors' sentiments. Self-fulfilling changes in expectations may lead investors to believe that a fixed parity will collapse and this will lead them to a speculative attack on a currency that has a fixed parity, even if there has been no change in the underlying fundamental determinants of exchange rates.

Then, the question to be addressed is the following: suppose that market investors start to believe that a future devaluation of the fixed parity might occur, i.e. their expectation becomes that the future exchange rate will be above the current fixed parity. Given this change in expectations, what can a central bank do to prevent the devaluation of the exchange rate from occurring? The answer to this question is simple: the central bank has to allow the domestic interest rate to rise above the world interest rate to make sure that the capital outflows induced by the expected depreciation of the domestic currency fail to materialize. To see how an expected depreciation of the domestic currency must lead to higher interest rates in a regime of fixed rate consider [Figure 15](#).

Suppose that, for whatever reason, there is a shock that leads investors to expect that the domestic exchange rate will depreciate in the future. Assume that, before this shock, the fixed rate regime was fully credible and agents were not expecting any depreciation of the exchange rate in the future, i.e.  $E_t(S_{t+1}) = S_t$ . For example, assume that both actual and expected exchange rates were equal to 1. Since  $E_t(S_{t+1}) = S_t$ , the domestic interest rate is initially equal to the foreign interest rate ( $i=i^*$ ), say 5%. Now suppose that after the shock occurs, market investors start to believe that a 7% future devaluation of the

domestic currency might occur; now we have  $E_t(S_{t+1})=1.07>S_t=1$  as the fixed exchange rate parity is not fully credible. The effect of this change in expectations is presented in Figure 15. The shock to expectations shifts to the right the curve representing the overall return on foreign bonds: for any given current exchange rate, the change in expectations increases the expected return on foreign assets from 5 to 12% (5% plus the 7% expected devaluation). As discussed in a previous section, if the economy was in a regime of flexible exchange rates, the change in expectations about the future exchange rate from 1 to 1.07 would lead to an immediate depreciation of the current domestic exchange rate at time  $t$ , from 1 to 1.07. In a regime of fixed exchange rates, instead, such a devaluation of the currency must be prevented. As Figure 15 shows, the only way to maintain the original exchange rate parity of 1 is to have an increase in the domestic interest rate from 5% to 12%. In fact, given the shock to expectations, domestic residents will not try to dump the domestic assets and currency in favor of the foreign assets only as long as the domestic assets provide a return equal to the expected return on foreign assets. Since the expected devaluation has increased the expected return on foreign assets from 5% to 12% the domestic interest rate has to go up from 5% to 12%.

As the figure shows, the increase in the domestic interest rate is achieved through an endogenous reduction in the domestic money supply from  $MS_1$  to  $MS_2$ . As in the case discussed before of an increase in the foreign interest rate, the reduction in the domestic money supply can be achieved in two equivalent ways. Either the central bank intervenes to defend the currency at the time when the change in expectations occurs and this intervention leads to a fall in the money supply; or, equivalently, the central bank performs an open market sale of government bonds that reduces the liquidity in the economy. Both actions have the effect of reducing the domestic money supply and increase the domestic interest rate. In the new equilibrium, the domestic interest rate has gone up from 5% to 12% while the foreign interest rate  $i^*$  is still equal to 5%. However, since investors expect a 7% depreciation of the domestic currency, the expected total return to foreign assets is 12% and this is the reason why the domestic interest rate must be now equal to 12% to make sure that a devaluation does not occur.

### **Sterilized and Non-Sterilized Foreign Exchange Rate Intervention**

Suppose now that the defense of the domestic currency occurs, as it is usually the case, through foreign exchange intervention: the central bank sells foreign reserves to the public and this leads to a reduction in the money supply and an increase in domestic interest rates. Before the intervention the central bank balance sheet was:

#### **Central Bank Balance Sheet**

<b>Assets</b>	<b>Liabilities</b>
<b>Treasury Bills held by the CB 300</b>	<b>Currency 500</b>
<b>Foreign Exchange Reserves 200</b>	

After the open market operation the money supply falls from 500 to 450:

#### **Central Bank Balance Sheet**

<b>Assets</b>	<b>Liabilities</b>
<b>Treasury Bills held by the CB 300</b>	<b>Currency 450</b>
<b>Foreign Exchange Reserves 150</b>	

This example of foreign exchange intervention is formally called "**non-sterilized intervention**" since the central bank allows the intervention to **affect** the equilibrium level of the money supply in the domestic economy.

There is however another type of forex intervention that takes the name of "sterilized intervention". To understand this type of intervention, suppose that you intervene in the foreign exchange market; such intervention, if it is not sterilized, would lead to a reduction in the money supply and an increase in domestic interest rates (as in Figures 14 and 15). Now suppose that, after you intervene, you want to sterilize, i.e. you want to eliminate the effects of your intervention on your money supply and interest rates. You might want to do that for a number of reasons: for example high interest rate might lead the economy into a recession. Then, how do you sterilize your intervention? The answer is that, after you intervene in the forex market, you bring back the money supply to its previous level via an open market purchase of domestic bonds. If you do that the central bank balance sheet becomes:

#### **Central Bank Balance Sheet**

<b>Assets</b>	<b>Liabilities</b>
<b>Treasury Bills held by the CB 350</b>	<b>Currency 500</b>
<b>Foreign Exchange Reserves 150</b>	

so that the money supply goes back to the level it had before the original forex intervention. Central banks often attempt to sterilize the effects of their intervention in the forex market to prevent changes in the domestic money supply and interest rates coming from such forex interventions. However, such sterilization policies have the negative consequences: in fact, in times when the domestic currency is subject to devaluation pressures, sterilized interventions do not allow the intervention to increase the domestic interest rate. Therefore, sterilized interventions do not eliminate the original cause for a pressure on the exchange rate. When your currency is subject to devaluation pressures and you are trying to maintain fixed exchange rates, the only way to defend the currency is to perform **non-sterilized interventions** that reduce the money supply and increase interest rates so that the incentive to dump domestic assets is eliminated. If your interventions are sterilized, you do not allow the intervention to affect your money supply and interest rates. Therefore, such sterilized interventions lead to further losses of foreign reserves as the original cause of the initial pressure on the exchange rate (higher expected returns on foreign assets relative to domestic assets) is not eliminated through higher domestic interest rates. So, if the market is telling you that your money supply should be equal to 450 and your interest rates equal to 12%, your attempt to keep the money supply at 500 will lead to further losses of forex reserves. In fact, after the sterilized intervention described above, the foreign exchange rate reserves will further fall from 150 to 100 to push down the money supply to its equilibrium value of 450:

#### **Central Bank Balance Sheet**

<b>Assets</b>	<b>Liabilities</b>
<b>Treasury Bills held by the CB 350</b>	<b>Currency 450</b>
<b>Foreign Exchange Reserves 100</b>	

This means that the only way to avoid persistent and continuous losses of foreign reserves is to allow the forex interventions to affect the money supply and interest rates, i.e. you should perform non-sterilized

interventions. This also means that, if sterilized interventions continue (in spite of exogenous pressures on your exchange rates), these policies will lead to a continuous fall of forex reserves and the eventual loss of all of them. However, when that occurs, you do not have any more reserves to defend your currency and the fixed exchange rate collapses. In other terms, a speculative attack on your currency leads to a loss of forex reserves and the collapse of the fixed exchange rate regime. You then get a big devaluation that restores the equilibrium in the foreign exchange market.

One lesson deriving from the above discussion is that fixed exchange rate regimes are often shaky and liable to collapse. The reasons for the observed collapse of fixed rate regimes is that the exchange rate is often fixed at a parity that is not consistent with the fundamentals in the economy. If that happens, the commitment to fixed exchange rates is not fully credible and, over time, investors will start to believe that a devaluation of the exchange rate might occur. This expectation of a future devaluation of the exchange rate is by itself a cause of pressure in the exchange rate market that forces the central bank to intervene and lose reserves. In the example of [Figure 8](#), if the fixed parity  $S^*$  is set at a level that is appreciated relative to the equilibrium exchange rate  $S'$ , the central bank will be forced to intervene continuously in order to prevent a currency depreciation. At every point in time, the market demand for foreign currency will be above the market supply of foreign currency and the central bank will keep on losing foreign reserves. Such loss of reserve is more likely to continue when the central bank intervention is sterilized so that domestic interest rates are not allowed to increase and stem the capital outflows that are putting pressure on the exchange rate.

Since the amount of foreign reserves in the central bank coffers is always limited, a fixed rate set at a value different from the fundamental equilibrium exchange rate will eventually lead reserves down to zero; at that point, the fixed parity cannot be defended and the currency is subject to a big devaluation that forces the central bank to move to a regime of flexible exchange rates.

There are several reasons why the fixed parity might be inconsistent with fundamentals and a fixed rate regime may be not fully credible. If domestic prices are higher than foreign prices (or domestic inflation is greater than foreign inflation) fixed exchange rates lead to a real appreciation of the domestic currency. Remember that the real exchange rate  $RER$  is equal to  $SP^*/P$ . If domestic prices  $P$  are growing faster than foreign prices  $P^*$  and the nominal exchange rate  $S$  is fixed, the real exchange rate appreciates, i.e. the relative price of imported good falls. This real appreciation causes a reduction in domestic exports and an increase in imports from the rest of the world. The ensuing reduction in supply of foreign currency (from reduced exports) and increase in the demand for foreign currency (from the increased demand for imports) leads to a pressure for the currency to depreciate. If the central bank wants to prevent this devaluation because of the goal of a fixed exchange rate, it will be forced to keep on losing reserves through foreign exchange interventions. That is not eventually sustainable as reserve losses will drive the latter to zero and cause a currency collapse.

Alternatively, the fixed parity may not be consistent with fundamentals because the government is running a budget deficit that is financed by the central bank. If the bonds issued by a government (who is running a budget deficit) are purchased by the central bank, this financing of the deficit is equivalent to an attempt to create seigniorage: the central bank buys the bonds issued by the government and gives to the government currency that is spent by the government. While under flexible exchange rates this increase in the money supply would lead to a currency depreciation, under fixed exchange rate this monetary financing of the budget deficit cannot increase the overall money supply, as the money supply is endogenous given the level of world interest rates. Therefore, the increase in the domestic credit to the government deriving from the central bank purchase of government bonds leads to a loss of foreign exchange reserves. Since the overall money supply is constant (under fixed rates), the increase in the central bank holdings of government debt are matched by a loss of foreign reserves. For example, suppose that initially the government budget deficit is zero, that the equilibrium level of the money

supply under fixed rates is 500 and that the central bank balance sheet is:

### **Central Bank Balance Sheet**

<b>Assets</b>	<b>Liabilities</b>
<b>Treasury Bills held by the CB 300</b>	<b>Currency 500</b>
<b>Foreign Exchange Reserves 200</b>	

Next, suppose that the government runs a budget deficit equal to 50b. Suppose that the government wants the central bank to finance this deficit via seigniorage, i.e. by printing money. Then, the government will sell 50b worth of government bonds to the central bank in exchange of 50b of new currency (note that if the government bonds had been sold to the private sector, the budget deficit would have been bond-financed rather than money-financed). In this case the, the central bank purchase of government bonds changes the central bank balance sheet as follows:

### **Central Bank Balance Sheet**

<b>Assets</b>	<b>Liabilities</b>
<b>Treasury Bills held by the CB 350</b>	<b>Currency 550</b>
<b>Foreign Exchange Reserves 200</b>	

However, now the money supply is higher than what is required to guarantee that domestic interest rates remain as high as foreign interest rates. The increase in the money supply tends to reduce domestic interest rates below foreign ones and leads investors to sell domestic assets and currency in order to buy foreign assets. In a regime of flexible exchange rates, such an increase in the money supply would lead to a currency depreciation. However, in a regime of fixed exchange rates, these incipient capital outflows and pressures on the exchange rate force the central bank to intervene to prevent the devaluation of the currency. Then, foreign reserves are lost in a quantity equal to the initial monetary financing of the budget deficit, i.e. the central bank loses 50b of foreign reserves and the money supply goes back to its initial value of 500:

### **Central Bank Balance Sheet**

<b>Assets</b>	<b>Liabilities</b>
<b>Treasury Bills held by the CB 350</b>	<b>Currency 500</b>
<b>Foreign Exchange Reserves 150</b>	

If the budget deficit persists over time and the central bank financing of it persists as well, foreign reserves will be eventually run down to zero and a fixed parity collapse will again occur. The lesson is that, under fixed exchange rates, a budget deficit that is financed with monetary means, will lead to a persistent and unstoppable loss of foreign reserves that will eventually lead to a currency collapse.

As an example of inconsistency of fixed exchange rate with fundamentals we look next at a case study from Mexico in the early 1980s.

### **Case Study of Fixed Exchange Rate Collapse: Mexico 1982**

The case of Mexico in 1982 shows what happens when you try to peg for too long the exchange rate to a parity that is inconsistent with fundamentals, PPP and budget deficits.

The story behind PPP is that exchange rates should eventually lead to comparable prices of goods in different countries. If goods are more expensive in Germany than the US, a fall in the value of the DM will bring them back into line. The evidence is that this tendency asserts itself eventually. When the exchange rate is fixed by government decree, as it is in many countries around the world, this mechanism operates a little differently. We're going to look at the collapse of the Mexican peso in 1982 as an example of what can happen. The short story is that the peso collapsed in 1982. Between early 1977 and early 1980, the peso traded in the neighborhood of 23 pesos per dollar, a level enforced by the Banco de Mexico, the Mexican central bank. We'll return shortly to how they did this. Through January of 1982, the rate crept up, hitting 26.6 the end of the month. On February 5, President Lopez-Portillo announced that the central bank would defend the peso "like a dog," presumably to assure financial markets that the government would not let the peso collapse. On February 19 this effort was abandoned, and the peso immediately fell 29 percent against the dollar, reaching 45 pesos to the dollar by the end of the month. The peso continued to fall throughout the decade, and was trading at about 3000 to the dollar by the early 1990s. The complete history of the peso for this period is illustrated in [Figure 16](#).

So what happened?

Fundamentals. There are several dimensions to this question, but the most obvious one is that Mexico's fixed exchange rate was inconsistent with its other policies. You can see in [Figure 17](#) that while Mexico attempted to fix its currency, its monetary policy led to much more rapid growth in its stock of money than in the US. This is illustrated by the "dash-dot" line in the figure, denoting the ratio of the money stock in Mexico to that in the US. The reason for this excessive increase in the Mexican money supply was the existence of large budget deficits in Mexico that were being financed by the central bank purchases of government debt; these purchases, in turn, led to excessive creation of money supply.

As a result of the monetary financing of its budget deficit, prices in Mexico rose more rapidly than those in the US, with Mexico averaging between 20 and 30 percent inflation between 1979 and 1981. The dashed line in Figure 17 depicts the sharp rise in the ratio of Mexican prices to American. By the end of 1981, prices had risen substantially more in Mexico than the US, leading many Mexicans to shift their spending and investments outside the country. By February 1982, the discrepancy in prices proved to be indefensible, and the peso imploded. In short, the enormous departure from PPP was too much for the system to withstand, so the exchange rate collapsed. You can see in the figure that the decline in the peso brought prices back into line with PPP (for a while).

Fixing the Exchange Rate. Another dimension to our question is the central bank's behavior. You might think that the central bank can simply announce an exchange rate, but a little thought will tell you it's not so easy. To take a slightly frivolous example, I could claim that my apartment is worth 2 million dollars, but if no one is willing to buy it for that price it's not clear that the statement means anything. For related reasons, the central bank must back up its claim to fix the exchange rate. In the simplest version of a fixed exchange rate, the central bank supports the price by buying and selling as much foreign currency as people want at the set price. If people want dollars, the bank supplies dollars, if they want pesos, the bank supplies pesos.

The Banco had some trouble backing up the exchange rate policy in February 1982, when a run on the peso depleted almost half of its reserves (see [Figure 18](#)). If they ran out of reserves, of course, they would be unable to deliver on their pledge to meet market demand at the current price. They compromised by letting the peso fall, which relieved some of the pressure for a time. In August of 1982, renewed pressure on the peso lowered reserves further. This time the bank outlawed many forex transactions, thereby taking the exchange rate out of the hands of the market. As the jargon would have it, the peso was no longer "convertible" into foreign currency without explicit permission from the central bank. In that sense, the official price was like the 2m claim for my apartment: virtually meaningless, since you could not generally buy or sell at that price. Those with permission were able to buy dollars cheaply, while others paid much higher prices in the parallel or black market. These exchange controls caused serious problems for both Mexican business and foreign businesses operating in Mexico, since without foreign currency they could not import foreign goods. And since foreign investors could not be assured of repatriating their earnings, many avoided investing in the first place. Many Mexicans, in fact, got their own assets out of the country ahead of time, sparked by their fear (subsequently borne out) that currency controls would make it impossible to do later. To summarize: el Banco tried to set the exchange rate at a level that was wildly inconsistent with the fundamental PPP value and with the monetary financing of budget deficits. When this didn't work, they let the peso fall and limited foreign exchange transactions.

Lessons. This series of events is (perhaps surprisingly) relatively common, and suggests some lessons for businesses operating in foreign countries.

1. Fixed exchange rates aren't fixed forever. They simply substitute infrequent large movements for more frequent smaller movements. If you get caught, they can kill you. Anyone holding pesos on February 19, 1982, lost 29 percent of their dollar-equivalent value in a day, and more after that.
2. Operate in hard currencies when you can. One strategy for dealing with such risk is to do business in dollars, or some other hard currency. US banks, for example, denominated their loans in dollars, so the collapse in the peso did not hurt them on its own. But the collapse of the economy that went with the fall in the peso did hurt them, with the result that most loans were repaid only in part. Mexicans, too, tried to switch to dollars, but government restrictions made this difficult to do on a large scale.
3. Enter after the fall. A colleague of George Soros's said once that the best opportunities come when situations change from "disaster" to "bad". Anyone entering the Mexican market in late 1982 or 1983 had, at least, the advantage of buying low.

### **Why Countries Fix the Exchange Rate and Why Fixed Exchange Rates Collapse**

We observed before that it is often quite hard to permanently fix exchange rates and that fixed exchange rate regime often collapse with a big devaluation. So why do countries like to fix their exchange rates? There are many reasons:

1. Under flexible exchange rates, the exchange rate might be affected by speculative factors that have little to do with fundamentals. These speculative factors might lead to excessive exchange rate volatility, misalignments of the nominal and real exchange rate from their equilibrium level and negative effects of production, trade and investment. High exchange rate volatility might increase the risk of assets and investment in a country and also reduce real trade in goods.
2. Flexible exchange rate leads to "beggar thy neighbour" policies where countries try to gain competitive advantage for their exports through policies of devaluation of the domestic currency. This is

a source of conflict among countries since devaluation exchange rate policies may be a substitute for protectionist trade policies.

3. Flexible exchange rates may be a cause of high inflation ( $p$ ) and fixed exchange rates allow a country to converge very fast to low levels of international inflation. This is very important. Suppose that the PPP holds either in the short-run or the long-run. Then:

$$P = S P^f$$

In growth rates, the domestic inflation rate ( $p$ ) is equal to the foreign inflation rate ( $p^f$ ) plus the rate of exchange rate depreciation ( $dS/S$ )

$$p = dS/S + p^f \quad 100\% = 97\% + 3\%$$

Suppose that world inflation is low (3%) while our small open economy is stuck in a high inflation equilibrium where inflation is 100%, and therefore the rate of depreciation is 97% per year (100% - 3%). In this small economy all prices, wages and nominal variables are growing at 100% per year, nominal interest rates are high (say 105 = 100% inflation plus 5% real rate) and the economy is stuck in this high inflation bad equilibrium. In this economy, wages are effectively indexed to inflation (either formally or informally) and all costs/price are growing at a nominal 100% rate.

Suppose that now we decide to fix the exchange rate to its current level. Then, instantaneously, the rate of currency depreciation goes to zero. In a true PPP world the inflation goes instantaneously down to the world level:

$$P = S P^f$$

$$p = dS/S + p^f \quad 3\% = 0\% + 3\% = 3\%$$

Since, with a fixed exchange rate  $S$  the price of imported good is now growing only at 3% per year, the cost of imported good and inputs in production also falls to 3% right away. With imported goods prices growing at 3% domestic firms cannot afford any more to increase prices at 100% per year since no one would buy the domestic goods and everyone would switch to the cheaper foreign goods. As prices of goods start to grow at 3% only, nominal wage growth will also fall right away to 3% since workers have now no reason to ask for a 100% increase in their nominal wages: a 3% increase will maintain their real wage constant over time. So in this ideal world, fixing the exchange rate is a miraculous and instantaneous cure for inflation. This cure occurs at zero cost since nothing should happen on the real side of the economy when the exchange rate is pegged. In particular, the real exchange rate is not affected since in the old equilibrium the 97% depreciation was necessary to cover the 97% inflation differential while now the inflation differential is zero so that no devaluation is needed to maintain a competitive nominal and real exchange rate:

$$RER = S P^f / P$$

$$\text{Rate of \% change or } RER = dS/S + p^f - p = 0 = 97 + 3 - 100$$

$$= 0 = 0 + 3 - 3$$

So, the big advantage of fixed exchange rates is that is a quick way to gain credibility in your attempt to reduce inflation from very high levels to very low levels in a country that is otherwise stuck historically in a bad high inflation equilibrium.

So, what is the problem with the above strategy of using the exchange rate as a **nominal anchor** for inflation expectations ?

While fixing the exchange rate is a fast way to disinflate an economy starting with high inflation, pegging the exchange rate will not reduce the inflation rate instantaneously to the world level. Inflation will fall a lot and very fast but maybe not right away to the 3% world level. Suppose inflation falls from 100% to 8% in a very short period of time but then remains at the 8% for a while. The reason why inflation will not fall all the way to 3% are many:

1. PPP does not hold exactly in the short run since domestic and foreign goods are not perfectly substitutable. So domestic firms will reduce their price inflation down from 100% to a much lower level but may not push it down to the world level. So some inflation above 3% will remain on domestic goods.
2. Since many wages are set in multi-year contract that are renewed only over time, the wage inflation might not fall right away to 3%. Many wage contracts were based on the old expected inflation (100%) and the adjustment of wages will occur slowly. Also, in countries where there is formal indexation of nominal wages, wage inflation is based on past (higher) inflation rather than current (lower) inflation; so this inertia in the wage setting in the economy means that wage inflation will remain above 3% for a while and therefore costs of production (and prices) will increase more than 3% for a while.

So, assume that inflation falls from 100% down to 8% when you fix your exchange rate. Then, the differential between domestic and foreign inflation is 5% (8% - 3%). Since now the exchange rate is fixed, even a small differential of inflation rates implies that domestic prices are growing faster than foreign imported good prices and therefore the real exchange rate is appreciating by 5% per year:

$$\text{Rate of \% change or RER} = dS/S + p^f - p = -5\% = 0 + 3 - 8\%$$

This appreciation of the real exchange rate implies a loss of competitiveness of the domestic economy: domestic country exports become more expensive relative to imported goods; this leads to a reduction in exports and an increase in imports that worsen the trade balance and the current account.

Now, while a 5% real appreciation seems pretty small, the point to notice is that it builds over time. 5% real appreciation per year means that the real appreciation is going to be 10% in 2 years, 15% in 3 years, 20% in 4 year and so on. So, an initial small real appreciation becomes very large when the exchange rate is strictly fixed while the domestic inflation has not converged to the world rate. Such a real appreciation will eventually cause very large trade deficits. Example: Mexico had a quasi fixed exchange rate relative to the dollar between 1990 and 1994. Since inflation in Mexico was about 5% above the US one, over those five years this implied a real appreciation of the Mexican Peso of about 25% relative to the parity of 1990. As a consequence, the current account that was close to balance in 1990 went to a 28 billion \$ deficit by the end of 1994.

So, the problem of anti-inflation stabilization policies that use the fixed exchange rate as the policy tool to fight inflation is that fixed rates lead to a real exchange rate appreciation and to a significant worsening of the current account.

One way to avoid the real appreciation of the currency in the transition to fix rates is to make sure that once inflation is down to 8% and there is a 5% inflation differential, the central bank allows the currency to depreciate at a 5% rate; i.e. instead of having strictly fixed rates, you follow a policy of **crawling peg** where the rate of crawl (currency depreciation) per year is limited to the remaining inflation differential (5%). Such a crawling peg exchange rate rule prevents an inflation differential from causing a real appreciation that is bad for the trade balance.

Countries that do not like the idea of following a crawling peg and who stick instead to tightly fixed rates argue that a crawling peg accommodates the inflation differential between home and the world and does not allow a full convergence of domestic inflation to the world level. So, it is argued that it is better to stick with completely fixed exchange rates to break as fast as possible the back of inflation and push faster to the world level. The problem with such a tough inflation and exchange rate policy is that, if there are in the economy structural factors that lead to a persistent wage and price inertia, the inflation rate will not fully converge to the world level and the lingering differential will cause a significant and progressively larger real appreciation and trade worsening.

So while a crawling peg prevents domestic inflation from fully converging to the world rate, it also prevents the real exchange rate from appreciating. A variant of the crawling peg would be to have a rate of crawl lower than the inflation differential (say 3% rather than the 5% inflation differential): the advantage of variant is that since the rate of crawl does not fully accommodate the inflation differential, domestic firms and workers will be pressed over time to reduce their price and wage inflation; on the other side, a rate of crawl of 3% will lead to some real appreciation and worsening of the trade balance but the real appreciation would not be as large as in the case of a totally fixed nominal exchange rate. Mexico and many European countries in the European Monetary System, however, kept their exchange rates tightly fixed and ended up with a huge real appreciation.

Now, if a fixed exchange rate leads over time to real appreciation and a worsening current account deficit, the fixity of the exchange rate becomes less and less sustainable (and less and less credible) over time. After a year of real appreciation, the current account deficit can be easily financed through foreign borrowing (capital inflows). Such inflows are eagerly flowing into the country in the early stages of the exchange rate stabilization since domestic rates are higher than world ones and there is no risk of depreciation since s id fixed. So, you get actually huge capital inflows that keep your currency strong. But over the years, as the real appreciation becomes worse and the current account keeps on worsening you need more and more foreign capital inflows to finance your current account deficit. In late stages of the drama, investors start to realize that your fixed rate is not sustainable and start to believe that a devaluation might occur. This expected depreciation leads to an increase in the expected return on foreign assets and, for given domestic interest rates, leads to capital outflows. Then the domestic foreign reserves of the central bank start to fall as it intervenes in the exchange rate market to defend its currency from depreciating. If the foreign exchange intervention is not sterilized, higher domestic interest rate are helpful to stabilize the exchange rate for a while. If the FX intervention is sterilized , the pressure on the exchange rate remains and the central bank keep on hemorrhaging its foreign reserves. As the doomsday approaches, the expected depreciation becomes more likely and its probability of occurring higher. Then the loss of reserves occurs at an even faster rate as capital outflows are occurring while the current account is worse and worse. When you finally have lost most of your foreign reserves, the exchange rate collapses and you move to flexible exchange rate. The speculative attack on your currency leads to a sharp and large devaluation of the exchange rate.

An example of the story just described is the case of the Mexican Peso in the 1990s that is discussed in detail in the Mexican case study. The attempt to peg the parity of the Peso in the early 1990s eventually led to a dramatic collapse of the Mexican currency in December 1994.

**The Asian Currency Crisis of 1997** ([See the paper by Roubini, Corsetti and Pesenti on the Causes of the Asian Crisis for a more detailed analysis of the issues discussed in this section](#))

We will consider next the economic and currency crisis in Asia in 1997-98. We will try to understand the causes of the currency crisis in light of what we have learned in the previous parts. The Table below presents the data on the current account balance of a sample of Asian countries in the 1990s. As the Table suggests, large and growing current account deficits were the norm in a number of Asian countries, Thailand, Malaysia, the Philippines and Korea in particular.

Current Account Balances (as a % of GDP)

	1990	1991	1992	1993	1994	1995	1996
Korea	-1.24	-3.16	-1.7	-0.16	-1.45	-1.91	-4.89
Indonesia	-4.4	-4.4	-2.46	-0.82	-1.54	-4.25	-3.41
Malaysia	-2.27	-9.08	-4.06	-10.11	-11.51	-13.45	-5.99
Philippines	-6.3	-2.46	-3.17	-6.69	-3.74	-5.06	-5.86
Singapore	9.45	12.36	12.38	8.48	18.12	17.93	16.26
Thailand	-8.74	-8.61	-6.28	-6.5	-7.16	-9	-9.18
Hong Kong	8.4	6.58	5.26	8.14	1.98	-2.21	0.58
China	3.02	3.07	1.09	-2.17	1.17	1.02	-0.34

Were the growing current imbalances observed in Asia partly caused by movements of the real exchange rate of these countries? And was the real appreciation caused by the choice of the exchange rate regime?

Note first that in Asia, the official exchange rate policy of many countries was one of pegging to the U.S. dollar. Hong Kong has actually a currency board with the parity tied to that of the US dollar. Other countries were formally pegging their exchange rate to a basket of currencies; however, the effective weight of the US dollar in the basket was so high that their policy can be characterized as an implicit peg to the US currency. In Malaysia, the currency moved in a 10% range of 2.7 to 2.5 ringitt to the US\$ for most of the years between 1990 and the beginning of 1997. The Thai Bath was effectively fixed in a narrow 25.2 to 25.6 to the US\$ from 1990 until 1997. In the Philippines, the Peso fluctuated in a 15% range of 28 to 24 between 1990 and the beginning of 1995 but was practically fixed at a 26.2 rate to the US dollar from the spring of 1995 until the beginning of 1997. Other countries followed a somewhat more flexible exchange rate policy. The Korean won followed periods of fixity to the US \$ but had a more flexible exchange rate regime. The Won depreciated in nominal terms from 1990 until the beginning of 1993 (from 700 to almost 800 won per dollar); next, it traded in a very narrow range of 800 to 770 won/\$ between the beginning of 1993 and the middle of 1996. Then, it started to depreciate by about 10% reaching a rate of 884 at the end of 1996. The Indonesian policy can be described as a policy of explicit real exchange rate targeting with the nominal rate falling from 1900 rupiah to the US \$ in

1990 to 2400 by the beginning of 1997. Taiwan also followed a policy of real exchange rate targeting allowing its currency to fall from a rate of 24 New Taiwan dollars per US\$ in 1990 to a rate of 27.8 by the end of 1996. In Singapore, the currency actually appreciated in nominal terms throughout the 1990s going from a rate of 1.7 in 1990 to a rate of 1.4 by the end of 1996. Finally, in China where inflation was in the double digits in the early 1990s, the currency was allowed to modestly depreciate between 1990 and 1993 but was drastically devalued by almost 50% in 1994; since then, the currency remained stable with a slight drift towards a nominal appreciation.

While such policy of pegging the exchange rate ensured in many Asian countries ensured the stability of the nominal exchange rate relative to the US currency, it also had the consequence that change in the nominal and real value of the dollar relative to the Japanese Yen and the European currencies had the consequence of affecting the real exchange rate of the Asian currencies pegged to the US dollar. Specifically, the dollar was on a downward nominal trend relative to the yen and mark between 1991 and 1995 reaching a low of 80 yen per dollar in the spring of 1995. During that period, the Asian currencies pegged to the U.S. experienced a real depreciation of their currencies, as they were depreciating relative to the Japanese and European currencies. However, after the spring of 1995, the dollar started to rapidly appreciated relative to most world currencies (the yen/dollar rate went from 80 in the spring to 1995 to over 125 in the summer of 1997, a 56% appreciation). As a consequence, the Asian currencies that were tied in nominal terms to the dollar also experienced a very rapid real appreciation.

Note also that a real exchange rate appreciation (from large capital inflows or any other reason) may cause a loss of competitiveness and a structural worsening of the trade balance which makes the current account deficit less sustainable. Thus, the current account deficit may be less sustainable when accompanied by a real exchange rate appreciation that leads to a misaligned currency value. In the case of Asia, the real appreciation might have been the consequence of the choice of the exchange rate regime, essentially a fixed peg to the U.S. dollar. The consequence of such a peg was that they led to large capital inflows attracted by favorable interest rate differentials and the expectation of low exchange rate risk given the policy of stable currency value. Such inflows prevented currency depreciations even if domestic inflation was higher than world inflation and at times led to nominal currency appreciation; this, in turn led to a real appreciation that was partly the cause of the large and growing current account imbalances.

As discussed above, a real appreciation of the currency may occur when the exchange rate is pegged and used as a nominal anchor for monetary policy (as it has been in most Asian countries) if the initial domestic inflation rate is above the world one and it does not converge rapidly to the world inflation rate. Therefore, the problem of anti-inflation stabilization policies that use the fixed exchange rate as the policy tool to fight inflation is that fixed rates lead to a real exchange rate appreciation and to a significant worsening of the current account. While the Asian countries had not experienced the large inflation rates of some Latin countries, their inflation rates were usually above those of the OECD group; therefore a policy of pegged parities might have contributed to the real appreciation observed in the 1990s.

If we look at the data on the real exchange rate of the Asian countries, we see the following. Taking 1990 as the base year, we observe that by the spring of 1997 the real exchange rate had appreciated by 19% in Malaysia, 23% in the Philippines, 12% in Thailand, 8% in Indonesia, 18% in Singapore, 30% in Hong Kong. In Korea, the currency had depreciated in real terms by 14% while in Taiwan there was a 10% real depreciation. Find data on China (real depreciation). This suggests that, with the exception of Korea, all the currencies that crashed in 1997 had experienced a significant amount of real appreciation. Note also that in several countries, a large part of the real appreciation occurred after 1995 in the period in which the dollar (to which these currencies were pegged) was becoming stronger.

It is important to note that the degree of real exchange rate appreciation seems to be correlated with the choice of the exchange rate regime: countries with a more fixed exchange rate regime experienced a much larger real appreciation. Conversely, countries such as Korea, Taiwan and China that followed a more flexible exchange rate regime experience a real depreciation. Note that Indonesia, that followed a regime closer to real exchange rate targeting, the degree of real appreciation was smaller than that of countries such as Thailand, Malaysia, Hong Kong and the Philippines that followed more closely regimes of fixed exchange rates.

The data also suggest that the degree of overvaluation was correlated with worsening of the current account: countries with more overvalued currencies were generally experiencing a larger worsening of the current account; while countries such as China and Taiwan that had experienced a real depreciation had current account surpluses. The exception was Korea that had large and increasing current account deficits while its currency had depreciated in real terms in the 1990s.

By early 1997, it was clear that several regional currencies were seriously overvalued and that such overvaluation was a factor in the worsening of the current account of many countries in the region. Real depreciations appeared to be necessary to adjust the current account position of the deficit countries.

It is important to not that in the 1990s there were several other factors that affected the competitive positions of the Asian currencies. First of all, the 50% nominal of the Chinese currency in 1994 led to a sharp real depreciation of the renminbi; the ensuing large and growing trade surpluses of China led to a significant loss of competitiveness in the rest of Asia. During the 1990s China, with wage level at a fraction of those in the rest of the region, started to produce and compete in many manufacturing sectors that had been the source of export growth for the East Asian countries. Second, after 1995 the rapid appreciation of the dollar led to a significant real appreciation of the Asian currencies that were pegged to it. Third, in 1995-96 there was a slump in the world demand for semi-conductors, one of important export products in the region. This led to a significant reduction in export growth by the region in 1996. Fourth, the continued economic weakness of Japan, that remained in a state of economic stagnation throughout the 1990s dampened the demand for regional exports, as over 30% of the Asian exports were going to the region.

Therefore, while the degree of real appreciation of the Asian currencies in the 1990s was not as large as the one observed in previous episodes of currency collapse (such as Mexico in 1994), the combination of the factors discussed above made the competitive position of most Asian countries quite fragile by the beginning of 1997.

In order to understand the currency crisis in 1997 and its spread from one country to the other, it is important to note that the measures of the real exchange rate presented above do not fully measure the competitiveness loss suffered by regional currencies whose currency had not yet depreciated once some countries in the region had started to devalue. Take for example the case of the Korean won. As many countries in the region compete in similar products in world and regional markets (US, Europe and Japan), when the currencies of Thailand, Malaysia, Indonesia and the Philippines started to depreciate over the summer while the Korean won remained relatively stable until October, this implied a significant loss of competitiveness for the Korean exporters. Specifically, if we take the end of 1996 as the base period, by the end of September 1997, the Thai Baht had depreciated relative to the US\$ by 42%, the Indonesian Rupiah by 37%, the Malaysian Ringitt by 26%, the Philippines Peso by 28%. The Korean won, instead, by the end of September had depreciated only by 8% (relative to December 1996). This implied that by the end of September, the won had appreciated in nominal (and real) terms by 34%, 29%, 20% and 18%, relative to the currencies of Thailand, Indonesia, the Philippines and Malaysia respectively. If we look at the official figures for the real exchange rate of the won we do not observe the drastic loss of competitiveness of the won between July and the end of September as such data are

based on aggregate trade-weighted (with 1990 base) data. While the official real exchange rate of the won is stable over that period, Korea actually suffered a dramatic loss of competitiveness during the summer months because the large devaluations of its regional trade competitors implied an effective real appreciation of the won and loss of competitive position

This effect of the depreciation of some regional currency on the "effective" real exchange rate and competitiveness of the other countries in the regions is a crucial element to understand why the currency contagion was importantly determined by fundamental factors. As one after the other, the currencies of countries that were competing in the same world market came under attack and started to depreciate, the equilibrium fundamental value of other currencies that had not depreciated yet started to become lower and the pressure on such currencies to depreciate to regain some of the competitiveness loss became even higher. This game of competitive devaluations is the fundamental factor that explains why the currency contagion and the domino effects were driven by fundamental factors.

Throughout the crisis a number of factors exacerbated the fundamentals that were feeding the currency crisis.

First, the currency depreciation worsened the real burden of external debt faced by governments, financial institutions and firms that had heavily borrowed in foreign currency.

Second, the financial problems faced by firms and financial institutions were repeatedly discovered to be far worse than originally announced generating significant uncertainty about the depth and breadth of the financial problems faced by firms and banks; then, the currency depreciation engineered by such uncertainty would ex-post worsen such financial conditions and validate further weakenings of the currencies.

Third, the fundamental domino effect described above where the currency devaluation in one country implied a worsening of the real appreciation of countries that had not depreciated yet transmitted speculative pressures to one currency after the other: in July and August, the fall of the baht spread to the ringitt, rupiah and the peso; by September, the contagion had spread to Singapore and Taiwan. Once the later two currencies fell, the speculative pressure spread within days to Hong Kong. By October, with six major currencies in the region having devalued by an average 40%, the Korean won could not maintain a parity that was now out of line with fundamentals. In turn, the sharp collapse of the won in November and December led to a significant real appreciation in the other regional currencies that was not sustainable given the shaky financial conditions of the countries; this is why such currencies continued to fall in November and December on the heels of the won crisis with each depreciation round feeding a spiral of the next series of depreciations. The persistent fall of the currencies of Thailand, Indonesia and the Philippines even after large bail-out packages had been arranged in the fall was certainly affected, among other factors, by the collapse of the won in November and December.

Fourth, significant political uncertainty led to serious policy uncertainty throughout the crisis. The government weakness, cabinet reshufflings and eventual government collapse in Thailand; the inflammatory statements by Malaysian PM against "rogue speculators"; the elections in Indonesia, political tensions and continued bad news about the health of the Indonesian president Suharto who has no apparent successor; the presidential elections and contradictory policy signals sent by then candidate (and eventually President elect) Kim Dae Jung; the threat of labor unrest in the region were all factors that added to the seriousness of the crisis.

Fifth, the economic problems of Japan, the leading regional economic exacerbated the crisis in a number of ways: 1) In 1996 it appeared that an economic recovery was returning in Japan after five years of zero

growth but the increase in the consumption tax in April 1997 spinned Japan in another economic recession: second and third quarter economic activity declined. 2) The economic weakness in Japan kept monetary policy loose, interest rate very low and induced a continued depreciation of the yen relative to the US \$ that exacerbated in the first part of 1997 the real appreciation faced by the other regional currency; the crisis finally exploded in the summer when the dollar was going through what seemed an unstoppable rise and the yen continued its decline. 3) Japanese banks, already in a fragile conditions after the burst of the 1980s asset bubble and weakened by a stagnant economy in the 1990s had heavily lent to other Asian economies. Therefore, the currency shock in Asia, the ensuing worsening of the financial conditions of Asian banks and firms and the ongoing bankruptcy of an increasing number of them implied a worsening of the financial conditions of Japanese banks and securities firm. Compared to the Mexican crisis of 1994-95 when the US, the major regional economic power was in a strong cyclical upswing, the weakness of Japan in 1997 exacerbated poor economic fundamentals in the region.

Sixth, the first reaction of the monetary authorities to the speculative pressures on the currencies was to try to avoid a monetary contraction and a significant increase in domestic interest rates. When the first pressures started in the spring, the reaction in Thailand and other countries was to perform sterilized interventions and, once such interventions turned out to be ineffective given their sterilized nature, several countries introduced capital controls to prevent capital outflows. The basic stance of monetary policy in the region remained quite loose well into the crisis; it is only when the fall of the currencies accelerated in the fall that a serious monetary tightening started to be implemented. For example, Malaysia waited until early December when the ringitt had already fallen by over 40% to officially changed its monetary stance and renounce its policy of low interest rates.

The reasons why governments delayed a monetary tightening and increase in interest rate that could have slowed down capital outflow and the currency fall were several. First, an interest rate increase would have led to a slowdown in economic activity that could turn recessionary. Second, given the fragility of the banking system and of the corporate sector, a monetary tightening would have led to a credit squeeze, corporate and banking bankruptcies and further negative effects on the level of economic activity. On the other side, a relatively loose monetary policy aimed at preventing further financial problems for firms and banks turned to worsen things because it led to a continuous spiral of currency depreciation that dramatically increased the real burden of the large foreign debt liabilities. At the end, when currencies kept on falling, monetary authorities were forced to tighten monetary and credit conditions. Paradoxically, such late tightening made things even worse because it came after the depreciations had already sharply increased the real external liabilities of the borrowers and it therefore led to a credit squeeze that increased the amount of non-performing loans, exacerbated the financial problems of banks and firms and was a source of a sharp deflationary effect on the level of real economic activity.

In order to understand the magnitude and depth of the financial crisis in 1997, it is very important to notice that the amounts of speculative capital inflows in Asia in the early 1990s was much larger than the already large figures presented above about the size of the net capital inflows. In fact, the estimates presented above of "other debt-creating net capital inflows" (portfolio assets, bonds, equity and bank borrowings) give a misleading and underestimated picture of the actual amount of speculative short-term capital inflows that occurred in the 1990s. When one looks at the data, one observes that gross inflows of short-term capital were significantly larger than the net inflows as there were large amounts of gross short-term capital outflows as well. To give an example, consider Korea in 1996 that is typical of the other countries' trends. In 1996, the current account deficit was \$23b. As shown in [Part 2](#), net FDI inflows were negative to the tune of \$2.1b. As foreign reserves increased by 1.4b, net capital inflows were by definition equal to \$24.4b. However, the gross amount of capital inflows was much larger than \$24.4b and actually equal to \$41.3b; the difference between the two is the amount of gross financial capital outflows.

This is important because while, on a net basis, the increase in the external debt of the Asian countries was equal to the current account deficit (minus the non-debt creating net FDI inflows), the increase in the gross external liabilities of these countries was significantly larger in the 1990s as large short-term capital inflows were also accompanied by very large capital outflows. This increase in gross external liabilities became a serious issue in 1997 because, once the currency crisis started, large gross capital outflows exacerbated the crisis in two ways.

First, as the currencies were falling, non-residents were repatriating the capital inflows by dumping domestic bonds, equities and other financial assets; on the other side, resident who had accumulated large stocks of financial capital abroad via the large capital outflows of the 1990s were unwilling to repatriate such foreign currency outflows as their domestic currencies were falling. Therefore, the degree of currency depreciation was magnified by the existence of a previous large stock of non-resident owned gross domestic assets that had been accumulated over the decade via large gross capital inflows.

Second, a large fraction of the gross capital inflows and outflows were in the banking sector. For example, in 1996 in Korea, of the \$23.3b "other investment capital inflows", \$12.3 went to the banking sector while of the \$11.8b "other investment capital outflows", \$9.5b were made by the banking system. This is consistent with the BIS data presented above that show a much larger increase in liabilities towards BIS reporting banks (gross capital inflows) than the increase in assets towards BIS reporting banks (gross capital outflows). This process of large gross intermediation of capital inflows and outflows through the banking system implied that the domestic Asian bank were increasing their foreign short-term liabilities towards BIS banks much faster than their foreign assets. For example in Korea, at the end 1993 the liabilities of the domestic banks towards BIS banks were equal to \$34.6b while their foreign assets (towards BIS banks) were equal to 13.7b, for a net liability position of 20.8b. But, between the end of 1993 and the second quarter of 1997, the gross liabilities went up to \$90.6b, a whopping increase of \$56b in only three years and six months; the gross assets went up to only to \$33.5b, an increase of \$19.8b. As a consequence, the net liability position of the Korean banking system went from \$20.8b at the end of 1993 to \$57.0b by 1997:2, an increase of \$36.2b. Note that similarly large increases in gross external liabilities of the banking and non-banking system are observed, controlling for country scale, in the other countries in the region where a currency crisis occurred, especially Thailand, Malaysia, Philippines and Indonesia.

The increase in the gross liabilities of the banking system in the 1990s was an independent cause of the worsening of the crisis and currency depreciation in 1997. For example, in Korea, once the real burden of the heavy gross borrowing by banks and non-banks was worsened by the depreciation of the currency and some financial institutions started to go bankrupt, a financial panic ensued. Since it was not clear which banks were solvent and which were not, foreign banks that had heavily lent to Korean banks started to refused to roll-over the loans that would have been automatically renewed in normal times. The foreign banks unwillingness to roll-over normal lines of credit in face of high risks of bankruptcy made the prospect of loans default more likely and led to a situation of financial panic where the currency collapsed in a week in December by over 40%; the currency collapse in turn made the default more likely. The situation calmed down only around Christmas when, faced with the prospect of a default induced by a self-fulfilling unwillingness to roll-over short-term debts, the American, European and Japanese banks jointly agreed to negotiate an orderly renewal of such short-term loans and the major creditor countries decided to anticipate a fraction of the bail-out package approved by the IMF in early December.

A similar cycle of currency crisis leading to a debt crisis was experienced by Indonesia: the continuous depreciation of the domestic currency increased the real burden of the large gross borrowing by banks and firms. As a consequence, financial panic emerged in Indonesia in early January 1998.

## Summary of the Analysis

In summary, our analysis of the causes of the Asian crisis in Parts 1-5 of this essay suggests the following conclusions.

First, several Asian currencies had appreciated in real terms in the 1990s and large and growing current account imbalances had emerged in the countries that faced a speculative attack in 1997. The overvaluation was due in part to the widespread choice of fixed exchange rate regimes in the region and the related large capital inflows in the 1990s. By early 1997, it was clear that several regional currencies were seriously overvalued and that such overvaluation was a factor in the worsening of the current account of many countries in the region. Real depreciations appeared to be increasing needed to adjust the current account position of the deficit countries.

Second, the current account imbalances and related growth of foreign debt was also driven by an investment boom (as well a consumption boom). Such investment boom was excessive and often in the wrong sectors (non-traded goods, real estate, speculative assets build-up).

Third, because of a moral hazard problem created by government promises of a bailout, banks borrowed too much from abroad and lent too much for investment projects that were too risky; moreover, the interest rate at which domestic banks could borrow abroad and lend at home was too low (relative to the riskiness of the projects being financed) so that domestic firms invested too much in projects that were marginal if not outright not profitable. Once these investment projects turned out not to be profitable, the firms (and the banks that lent them large sum) found themselves with a huge amount of foreign debt (mostly in foreign currencies) that could not be repaid. The exchange rate crisis that ensued exacerbated the problem as the currency depreciation dramatically increased real burden in domestic currencies of the debt that was denominated in foreign currencies.

Fourth, a significant fraction of the borrowing and lending was not going to finance new investment projects (that would have increased the stock of capital); instead, the loans were financing speculative demand of existing assets in fixed supply (land, existing real estates, the outstanding stock of equity). Evidence on this is provided by the movements of asset prices (especially stock markets, land values and real estate prices) that were increasing faster than warranted by economic fundamentals. The asset price bubble (in stock markets, land and real estate prices) was fed by the excessive borrowing by banks in international capital markets; therefore, part of the accumulation of foreign liabilities went to the financing of the speculative asset bubble. When this bubble burst in 1997, the firms, banks and investors that had borrowed these funds were left with a large stock of foreign debt that could not be easily repaid. Again, the collapse of the currencies worsened this debt problem by increasing the real burden of the foreign liabilities.

Fifth, in order to understand the currency crisis in 1997 and its contagion from one country to the other, it is important to notice that the depreciation of some regional currency appreciated the "effective" real exchange rate and worsened the competitiveness of the other countries in the region that had not depreciated yet. As one after the other, the currencies of countries that were competing in the same world market came under attack and started to depreciate, the equilibrium fundamental value of other currencies that had not depreciated yet started to become lower and the pressure on such currencies to depreciate to regain some of the competitiveness loss became even higher. This game of competitive devaluations is an important factor that explains why the currency contagion and the domino effects were driven by fundamental factors rather than irrational contagion.

In summary, fixed exchange rates regimes, capital inflows and moral hazard jointly led to real

appreciation, an investment boom in wrong sectors, an asset price bubble and large current account deficits that led to the accumulation of a large stock of short-term foreign liabilities. Such deficits were financed mostly through banking system intermediation (given the lack of developed securities markets in the region): banks borrowed abroad in foreign currency and their borrowings were mostly short-term; these large currency positions were mostly unhedged as firms and banks expected the fixed rate to be maintained and/or to be bailed-out if things went wrong. Once the firms' investment projects turned out not to be very profitable, the firms and the banks found themselves with a huge amount of currency-denominated foreign debt that could not be repaid. The exchange rate crisis that followed made things only worse as the currency depreciation increased the real burden of the foreign-currency denominated debt. Weak and not very credible governments that were not committed to structural reform exacerbated the policy uncertainty and the financial panic that followed.

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## Further Readings

See the [Asian Crisis homepage](#) and the [paper by Roubini, Corsetti and Pesenti on the Causes of the Crisis](#) (the file is in PDF format; you need the [Adobe Acrobat Reader](#) to read this file).



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