Money and Exchange rates

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So far we have learned that monetary policy can affect the interest rate and output in the short run and that in the long run it does not affect real interest rates nor output but it affects prices (long run money neutrality). Now we will focus on the effects of monetary policy on the international variables focusing in particular on exchange rates.

Real and Nominal Exchange Rates

We usually refer to two types of exchange rates: real and nominal.

The nominal exchange rate is just the price of a currency (i.e. of the piece of paper issued by the central bank of a given country) in terms of another. The convention is that the higher is the exchange rate the more expansive is the foreign currency, relative to the domestic one. In other words the nominal exchange rate tells me how many units of my own currency I need to buy one unit of foreign currency. Canadians will say that the exchange rate of the Canadian dollars relative to US dollar is 1.5 and they mean they need to use 1.5 Canadian dollars to purchase 1 US dollar. We say that a currency depreciates when the exchange rate increases (i.e. I need more domestic currency to get a unit of foreign) and it appreciates when the exchange rate falls. (This is just a convention and sometimes people use the opposite i.e. the define the exchange rate as the price of the domestic currency in terms of the foreign, in that case all signs are reversed).

The real exchange rate is the price of a particular foreign good or basket of goods (expressed in the same currency) relative to the domestic one. Again it tells me how many domestic goods do I need to get one unit of the foreign one. An example of that is how many Prada suits do I need to buy a Calvin Klein US suit. A possible way of measuring this is to sell my Prada suit, exchange my Euro revenue in Dollars and then compare the sum with the price of the CK suit. For example if the price of Prada suit in Italy is 800 Euros, and the exchange rate between the Euro and the Dollar is 0.8 I get 1000 dollars from selling the Prada suit. If the price of a CK suit in US is 500 Dollars this means I need a 1/2 Prada suit to buy a CK suit, or that the

real exchange rate for suits is 1/2. In this example Italian suits are more expensive than American suits so American suit makers are going to be more competitive on the world markets (all throughout the discussion we are assuming the two suits have the same quality) So the real exchange rate is also a measure of competitiveness.

Most often instead of focusing on a single good we focus on the price of an aggregate of goods (like the basket that compose the CPI) so the real exchange rate is computed as

$$rx = \frac{P * e}{P}$$

where P is the domestic general price level, e is the nominal exchange rate and P^* is the foreign price level. Consider again the case of US versus Europe. If the European real exchange rate goes up (i.e. the Euro depreciates) is either because P^* (American prices) goes up, or because e goes up (the Euro depreciates) or because P goes down (the euro prices go down) In all these cases we observe an increase in competitiveness of European goods relative to US goods. Often also instead of just the real (or nominal) exchange rate with one country statistics report the value of the dollar against a group of currencies or the value of the American goods versus the rest of the world goods. Figure 1 plots the nominal exchange rate and the real exchange rate of the dollar versus a broad group currencies.

Purchasing power parity as an exchange rate theory

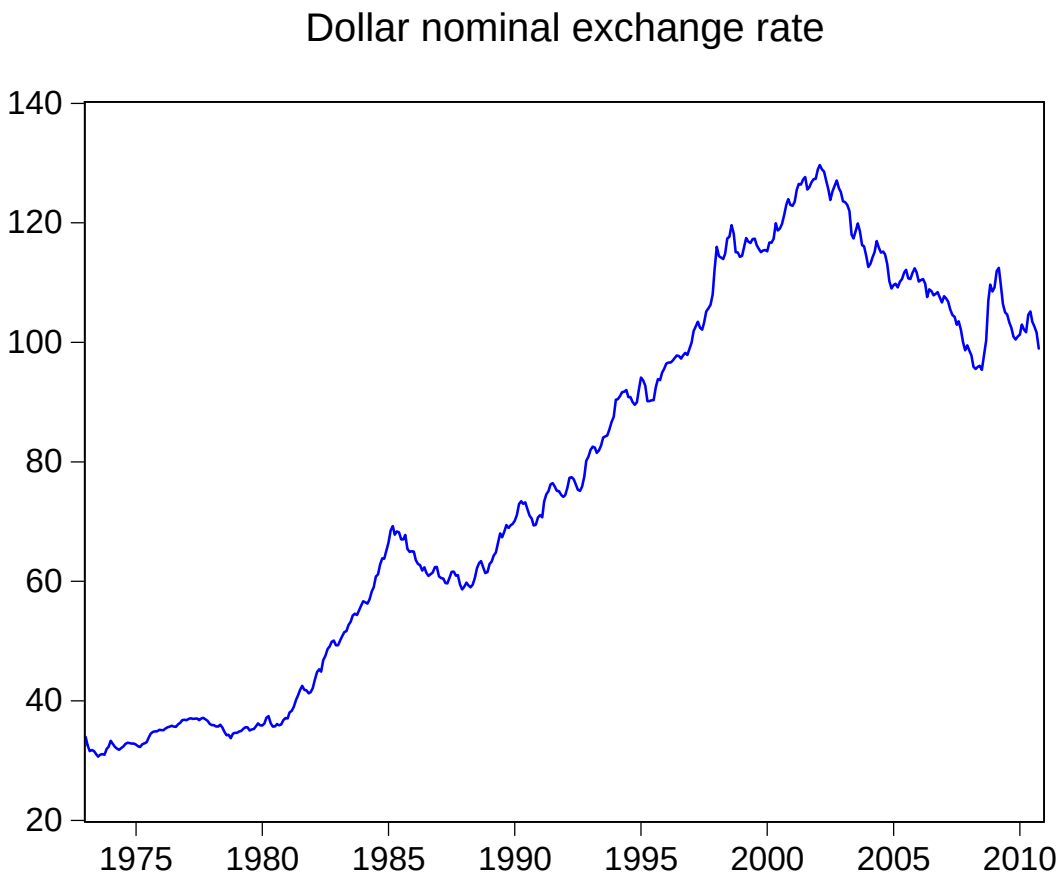
Figure 1 reveals that nominal exchange rate fluctuates a great deal and can have long run trends. The purchasing power parity theory can provide us some guidance on the directions of these fluctuations, in particular the long run trends. The dollar price of a basket of goods and services in US is P^{US} The dollar price of a comparable basket abroad is P^*/e where e is the number of foreign currency units that I can get for a dollar (so e is the strength of the dollar). Purchasing power parity says that the nominal exchange rate should adjust (because arbitrage in goods market) so that costs are equalized across countries. The equalization of costs implies that

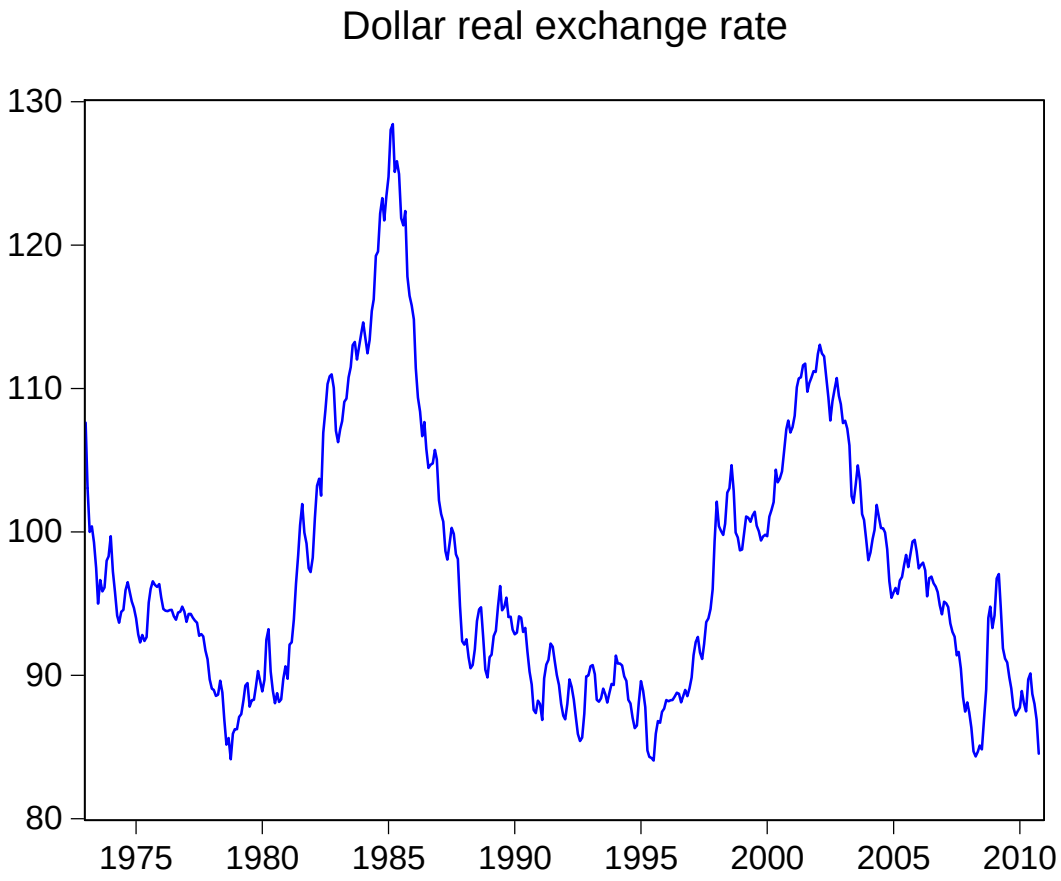
$$P^{US} = P^*/e$$

or

$$P^{US}e/P^* = rx = 1 \tag{1}$$

that is it implies that the nominal exchange rate should move so to keep the real exchange rate constant. Suppose for example that we start in a situation of purchasing power parity ($rx = 1$) and that foreign prices go up 10% while domestic prices are constant. If the exchange rate does not move domestic goods will be cheaper and foreigners will rush to buy them; to buy domestic goods foreigners will need to exchange their currency for local currency, driving up the price of the local currency (e


Dollar nominal exchange rate
140
120
100
80
60
40
20
1975
1980
1985
1990
1995
2000
2005
2010


Dollar real exchange rate
130
120
110
100
90
80
1975
1980
1985
1990
1995
2000
2005
2010

goes up) until purchasing power parity is restored. Obviously purchasing power parity does not hold in the short run (just observe the second panel in figure 1 that shows large fluctuations in the real exchange rate) so the theory does not help us to predict day to day movement in the exchange rate (one of the many reasons why the theory does not hold is the presence of non tradable goods, or trade restrictions that reduce the possibility for arbitrage). Notice though that in the long run the real exchange rate reverts toward a constant mean, while the nominal does not, indicating that the theory is somehow helpful in predicting long run changes in the nominal exchange rate. For example, figure 1 suggests that the reason why the dollar has appreciated against the foreign currencies has been foreign prices increasing more than US prices. Along these lines the PPP theory, in conjunction with the quantity theory of money, is helpful in understanding the long run impact of money expansion on exchange rates. In particular consider taking logs and time differences of equation 1 one gets

$$\begin{aligned} \log(e_{t+1}) - \log(e_t) &= (\log P^*_{t+1} - \log P^*_t) - (\log P^{US}_{t+1} - \log P^{US}_t) \\ &= \pi^*_t - \pi_t \end{aligned}$$

suggesting that the change in exchange rate between two countries should be related to the relative inflation in those 2 countries, where higher inflation leads to more depreciation. The quantity theory tells us that

$$\begin{aligned} \pi_t &= g_M - g_Y \\ \pi^*_t &= g^*_M - g^*_Y \end{aligned}$$

hence we get

$$\log(e_{t+1}) - \log(e_t) = g^*_M - g^*_Y - g_M + g_Y \tag{2}$$

Equation 2 connects the PPP theory with the quantity theory of money to provide a long run theory of the evolution of the nominal exchange rate. If, for example, US expands its money supply more than its foreign partners the quantity theory predicts that US prices should grow more than foreign prices. But if in the long run the real exchange rate between US and Europe is constant (PPP) it must be that the nominal value of the dollar falls ($\log(e_{t+1}) - \log(e_t) < 0$) so US money expansion causes depreciation of the dollar. Similarly should US experience faster real growth than its partners, US should see an appreciation of the nominal exchange rate, because a faster growth would increase the world demand for dollars. This effect is very visible in the case of very rapid price changes (for example hyperinflations): countries that experience rapid price changes also experience rapid depreciation, so that their real exchange rate does not change much. Next we will try to understand the short run behavior of exchange rates and to do so we need to discuss explicitly exchange rate policies.

Exchange rate regimes

A large number of countries (for example US, UK, Japan) follow a policy of floating exchange rates, that is they leave the markets to determine the equilibrium value of the their currency against other currencies. Some other countries let the exchange rate float but they intervene on the foreign exchange market (buying or selling their own currency) from time to time to limit exchange rate variability: such policies are called managed floating exchange rate or dirty floating. Other countries decide to peg the exchange rate of their currency against some other currency (for example the Euro or the dollar). Pegging the exchange rate means that the Central Bank stands ready to exchange dollars for the local currency and local currency for dollars at a fixed value. We distinguish between moving (or crawling) pegs in which the target value for the change rates changes over time and frozen pegs in which the target exchange rate does not change. An example of moving peg is China now, it has been Brazil before the 1999 crisis, with a moving target for the value of the local currency relative to the dollar, or Turkey before the 2001 crisis, that had a target of scheduled devaluations of its currency against a basket of currencies. An example of a frozen peg was Argentina in the 1990s. There the Central Bank stood ready to exchange one dollar for one unit of local currency since 1991. In order for the frozen peg to be credible the bank must have enough dollars to satisfy any possible demand. Notice that there is important difference between dollars and local currency: local currency can be printed by the local central bank but dollars cannot, so a central bank can run out of dollars.

In order to implement a credible frozen peg some countries have adopted an institution called currency board: under a currency board any new unit of foreign currency that is issued has to be backed by a dollar in the vaults of central bank. In this case the bank will never run short of dollars and will be able to satisfy the demand of people wanting to exchange local currency for dollars. Example of currency boards are Argentina in the 1990s and Hong Kong. A more extreme way of fixing exchange rate is to give up the domestic currency altogether. This can be done in two ways.

One possible way is to form a monetary union (that is what happened in Europe). The currencies of the single countries will be replaced by a single currency so that there will be no longer issues of exchange rates like there are no issues of exchange rate between the dollar in California and the dollar in Minnesota.

The other possible way is the so called dollarization. This is what happened in Panama long time ago and recently in Ecuador: the central bank goes out of business and people just use dollars for every transaction. There is an important difference between dollarization and currency (or monetary) unions. In a currency union the countries in the union give up their monetary independence but they have some control over the central monetary authority that should act on behalf of all members of the union. So in the case of Europe for example the European Central Bank will

not solely act on behalf of the French interest but French will have some say on the European monetary policy. Dollarization on the other hand is a unilateral decision and the country that dollarizes has and expect to have no control whatsoever over the supply of dollars. The table below summarizes the possible exchange rate regimes.

Exchange Rate Regimes
Floating
Managed Floating (Target Zone)
Moving Peg
Frozen Peg (Currency Board)
Monetary union
Currency Abandonment (Dollarization)

Monetary policy under fixed exchange rates: speculative attacks

Fixing the exchange rate imposes a constraint on monetary policy. This is apparent if one thinks of dollarization: by giving up its own currency the country clearly gives up monetary policy as well. Also in the case of a currency board the constraint is pretty clear, because by law the central bank cannot print and inject the local currency if they don't have dollar reserves to back the liquidity. If a country decides to fix the exchange rate without adopting a currency board (as in the case of Mexico) the constraint arises from the fact that if the central bank prints too much money, the country is subject to speculative attacks that can force the country to abandon the policy of fix exchange rate.

In order to understand this concept is useful to analyze the balance sheet of a central bank (for example the Central Bank of Mexico) who tries to peg the exchange rate of the Peso to the dollar to the value of 1 (one peso for one dollar)

Assets ('000)	Liabilities ('000)
Foreign exchange Reserves \$100	Currency = $P1000$

the previous balance sheet shows that if the bank is not under a currency board the outstanding amount of currency can be higher than the amount of foreign reserves. But suppose now that agents in the market start believing that the peso will be devalued (so one dollar will exchange for two pesos); then it is convenient for them to exchange their pesos for dollars to realize a capital gain. They will start to do so, and in doing so they will attack the reserves of the central bank. Indeed in the case of a successful attacj they will keep going until the central bank finishes the reserves: at that point the balance sheet of the central bank will look like

Assets ('000)	Liabilities ('000)
Foreign exchange Reserves \$0	Currency = $P900$

at this point the central bank will no longer be able to exchange dollar for pesos so the exchange rate cannot be maintained fixed and the peso will actually be devaluated. Clearly if the amount of outstanding currency is always less or equal than the foreign exchange reserves (as in the currency board) there is no possibility of an attack because the speculators will finish the pesos before the bank exhaust the reserves. The problem with currency boards is that there are established by a law but there is no guarantee they will last forever so there is always the possibility that government decide to abandon them and then the exchange regime would collapse.

Interest rates under fixed exchange rates

Another way of seeing the fact that under fixed exchange rate a country loses its monetary independence comes from the interest rate side.

Let's consider the case of Argentina as the home country and let's consider the FFR and the equivalent of the Federal Funds Rate in Argentina that is denominated in pesos (suppose that they are both free of risk of default)

i_P	Interest rate on Peso funds
$\mathrm{i}_\$$	Interest Rate on Federal Funds
$\mathrm{e}_{P/\$}$	Peso Dollar rate (How many pesos do I need to get a dollar today)
$\mathrm{e}^e_{P/\$}$	Peso Dollar expected rate

Let's now compare the return on two assets using the same currency (the dollar). Suppose an international investor is contemplating investing one dollar in a the federal funds or in Peso funds. If she invests in the federal funds her return will be

$$\text{Return on Dollar assets (in dollar)} = (1 + i_\$).$$

If she invests in pesos she will first need to exchange the dollar in pesos obtaining $e_{P/\$}$ pesos then invest in deposits yielding a rate of $(1+\mathrm{i}_P)$ and then exchange back the pesos into dollars at an expected exchange rate of $\frac{1}{e^e_{P/\$}}$.Summarizing these operations we can write here expected returns as

$$\text{Return on Peso assets (in dollar)} = (1 + i_P)\frac{e_{P/\$}}{e^e_{P/\$}}$$

notice that this return is composed of two parts: the return on the Peso asset and the expected appreciation of the currency (this second part can be negative).

The (uncovered) interest parity condition

We will now determine the equilibrium in the foreign exchange market. We say that the foreign exchange market (between dollar and pesos) is in equilibrium when the expected return on dollar assets is equal to the expected return on peso assets that is

$$\begin{aligned} \text{Return on Dollar assets (in dollar)} &= \text{Return on Peso assets (in dollar)} \\ (1+i_{\$}) &= (1+i_P)\frac{e_{P/\$}}{e^e_{P/\$}} \end{aligned}$$

taking logs of the previous condition we also have

$$\begin{aligned} i_{\$} &= i_P + \log(e_{P/\$}) - \log(e^e_{P/\$}) \\ i_{\$} &= i_P - \text{Expected \% peso depreciation} \end{aligned}$$

to make things clear suppose that the interest rate on dollar assets is 6% and the one on peso rate is 10%. Suppose that the exchange rate today is 1 and that is expected to go to 1.05, that is the peso is expected to depreciate 5%. In this case the return on dollar assets will be 6% but the return on peso assets will be 10% - 5% = 5% so the left hand side of the parity above is higher than the right hand side. In this case dollar assets are a better options and everybody will try to sell peso deposits and buy dollar assets. But this will tend to instantly depreciate the peso (raise $e_{P/\$}$) until the parity is restored.

Now consider the case in which the exchange rate is fixed. In this case the expected exchange rate is equal to the current exchange rate ($e_{P/\$} = e^e_{P/\$}$) and therefore the parity above becomes simply

$$i_{\$} = i_P$$

this implies that the central bank of Argentina does not have any control on its interest rate but its interest rate has to be equal to the Federal Funds Rates that is actually decided by the FED.

Figure 2 plots Argentina's interbank rate against the Federal Funds rate during the period in which Argentina had fixed exchange rate. Notice that obviously markets did not always believe that the exchange rate was going to be fixed, but at time in which they did (for example the 1995-96 period) the Argie rate was locked with the US rate.

Potentially this equation can also be used to determine the effects that changes in the interest rate have on the exchange rate (in a flexible exchange rate regime). Consider for example the uncovered interest parity for the dollar/euro

$$i_{\$} - i_E = \log(e_{E/\$}) - \log(e^e_{E/\$})$$

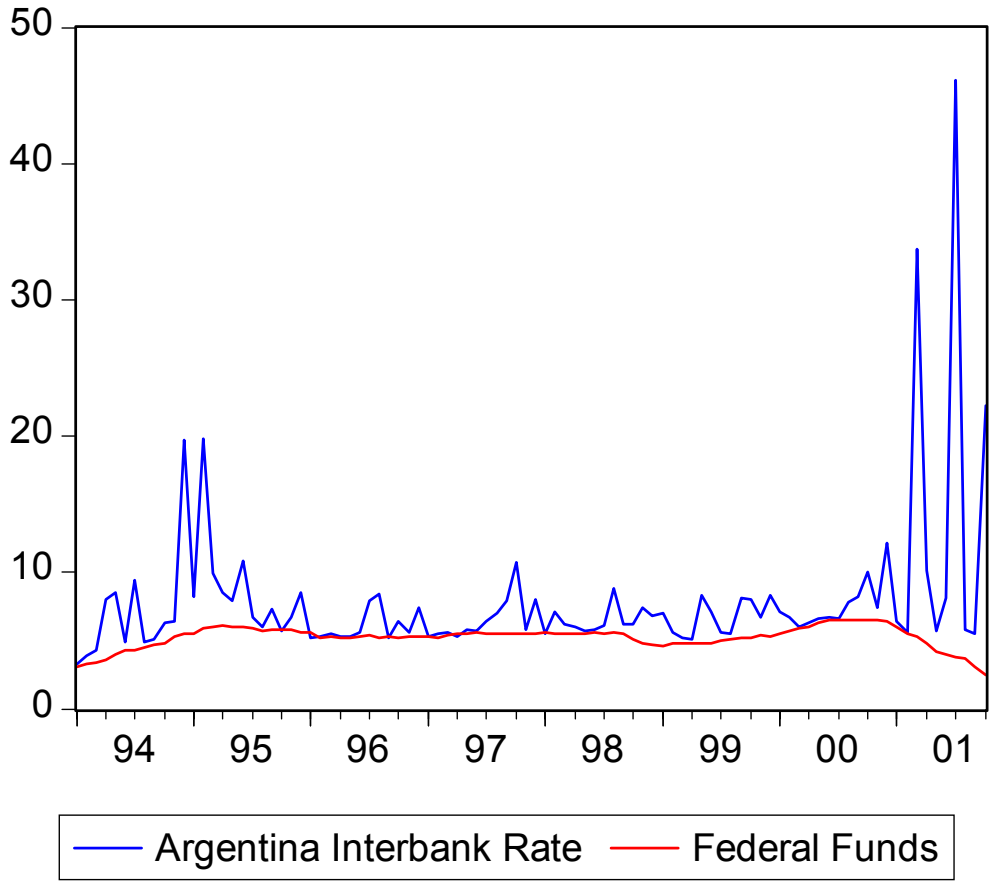


Figure 2: Argentine and US interest rate

the theory tells us that in period in which the Dollar interest rate is above the Euro rate we should expect the dollar to depreciate (relative to the Euro) and viceversa. Although this theory works sometimes there are many other times in which the theory fails miserably. Figure 3 shows the Euro and Dollar rate (on the London interbank market, LIBOR) together with the Euro dollar exchange rate (the blue line). Notice how in some periods (for example 1998-2005) the dollar exchange rate behaves in almost exactly the opposite way from what predicted. When, for example US interest rate is above Euro rate the Dollar should be depreciating but instead it appreciates. This suggests that the uncovered interest parity can be used to understand actual or expected exchange rate movements in presence of large interest differentials and large exchange rates swings (which happens often in emerging markets) but it is less useful when the interest rate differentials are smaller and there are potentially many other factors (such as risk premia, financial crises) that affect the fluctuations in exchange rates.

Concepts you should know

1. Real and nominal exchange rate
2. PPP
3. Exchange rate regimes
4. Uncovered interest parity
5. Speculative attacks

Review Question
Suppose the Swiss Central Bank announces that they are going to fix the exchange rate of the Swiss Franc with the Euro at 1 (i.e. 1 SF for 1 Euro). Suppose that after the announcement the interest rate on SF denominated bonds is 4% and the rate on Euro denominated bonds is 2%. Suppose that for both bonds there is no risk of default.

1. Do the market expect the exchange rate is going to stay fixed? Why or why not? If not in which directions they expect it to move.
2. Briefly explain why central banks which promise fixed exchange rate policies sometimes are not able to maintain those promises.

Answer

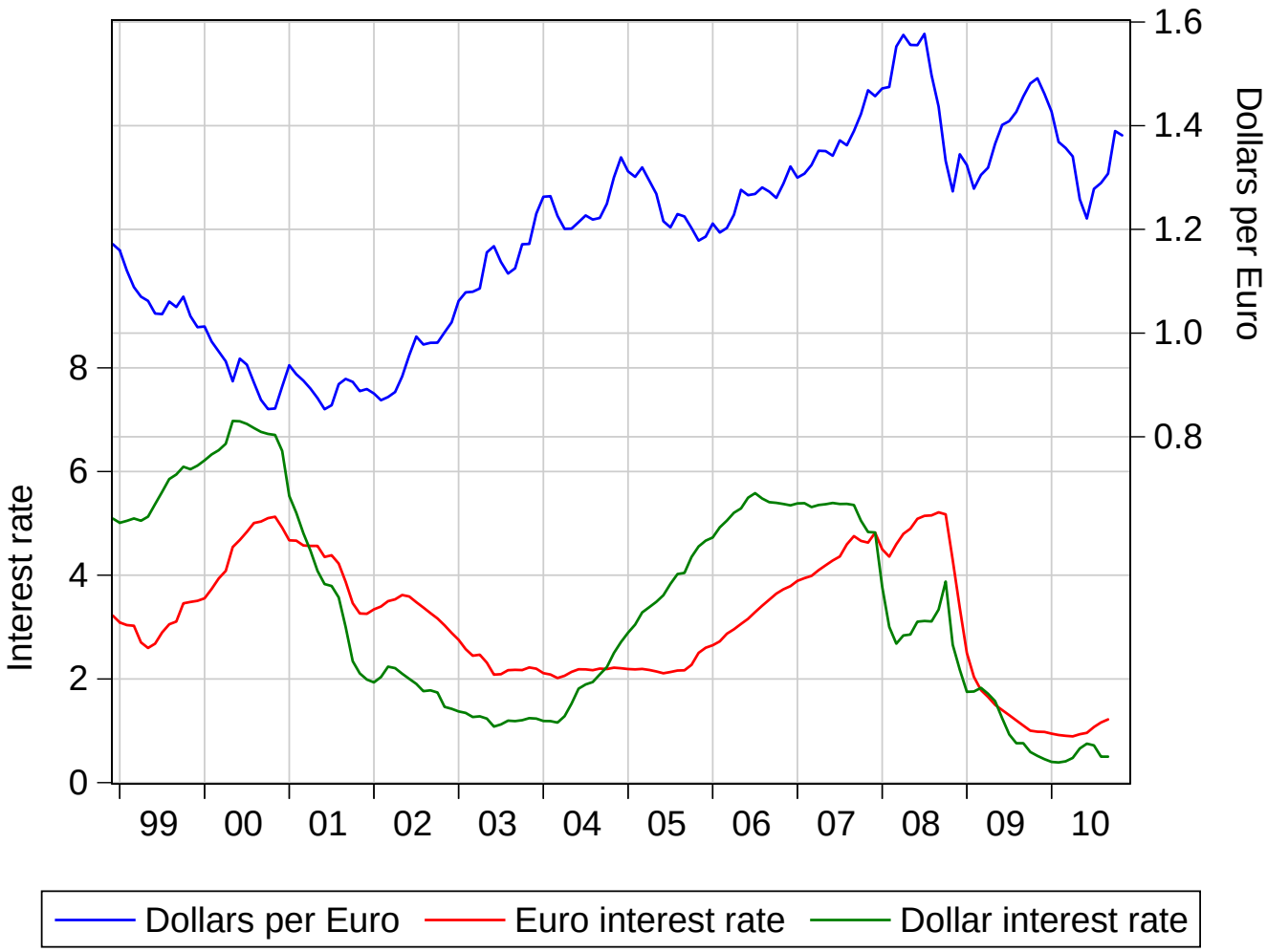


Figure 3: The Euro and the Dollar

1. No because from the UIP the expected depreciation of currency A relative to currency B is given by
$$i^A - i^B$$
so the market expect a 2% depreciation of the Swiss franc

2. To credibly maintain a fixed exchange rate of a give currency v/s a reserve currency (say the Euro) a central bank must not print money in excess of its dollar reserves. In many instances (for example recession or high government spending) the central bank ends up printing more money than their reserves and in these cases the fixed exchange rate system goes under attack and the central bank no longer can maintain the promise.