Macroeconomics Analysis II, EC3102

Tutorial 5

Question 1. *The hazards of fixed exchange rates.*

In this question, you will use the fiscal theory of exchange rates to analyze the collapse of Argentina's fixed exchange rate in early 2002. The model is just as we have studied in class – in particular, consumption is constant at $\bar{c}$ in every period, real money demand is described by the function, $\frac{M_t}{P_t} = \phi(\bar{c}, i_t)$, PPP holds, and the foreign price level is equal to one in every period (i.e., $P_t^\star = 1$ in every period t). Argentina runs a fiscal deficit of $DEF = 5.5$ every period, and there is no political will to ever reduce this deficit. The real money demand function is given by $\phi(\bar{c}, i_t) = \bar{c} - 10 \cdot i_t$, with $\bar{c} = 11$, and the exchange rate that Argentina is pegging (for as long as it can) is $E = 1$ peso per U.S. dollar. Finally, the foreign real interest rate is $r^* = 0.10$, the government starts period 1 with foreign reserves of $B_0^G = 22$, and foreign reserves can never go below zero.

a. As long as the fixed exchange rate is in place and is expected to remain in place, what is the numerical value of Argentina's nominal interest rate? Briefly justify your answer.

b. As long as the fixed exchange rate is in place and is expected to remain in place, what is the numerical value of seignorage revenue for Argentina? Briefly justify your answer.

c. As long as the fixed exchange rate is in place and is expected to remain in place, what is the numerical value of Argentina's BOP surplus or BOP deficit? Briefly justify your answer.

d. If Argentine residents for some reason never expect a devaluation of the peso, how many periods will the fixed exchange rate last? Briefly justify your answer.

e. If Argentine residents expect a 50 percent devaluation of the peso (that is, in terms of our notation from class $\mu = 0.50$) **in the very next period**, what is the numerical value of the nominal interest rate in Argentina **in the current period**? Briefly justify your answer, and provide economic intuition for what you find.

f. If Argentine residents do eventually come to expect a devaluation of the peso of 50 percent (as in part e), how many periods will the fixed exchange rate last? Carefully justify your answer, and also discuss the economic reason why there is (or is not) any difference between what you find here and what you found in part d.

Solution:

a) Use the interest parity condition. If the peg is expected to remain in place, that means $E^e_{t+1} = E_t = \bar{E}$, so the interest parity condition tells us that the domestic nominal interest rate equals the foreign real interest, so $i_t = r^\star = 0.10$ during this time.

Comment: To see this, let's look at the interest parity condition:

$$(1 + i_t) = (1 + r^\star)\frac{E^e_{t+1}}{E_t} \qquad (1)$$

Since $E^e_{t+1} = E_t \Longrightarrow \frac{E^e_{t+1}}{E_t} = 1$

So from (1), we have: $(1 + i_t) = (1 + r^\star)$

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b) Because, as we just found in part a, the domestic nominal interest rate is constant during this period, money demand (and hence in equilibrium money supply) must also be constant during this period.

From the money demand function,

$$\phi(\bar{c}, i_t) = P_t(\bar{c} - 10 \cdot i_t) = E_t(\bar{c} - 10 \cdot i_t)$$

we can see that $\bar{c}$ is unchanging and meanwhile, due to the fixed exchange rate policy, the interest rate is not changing with time (that is $i_t = i_{t-1}$). Thus for any time t,

$$M_{t-1} = \phi(\bar{c}, i_{t-1}) = \bar{c} - 10 \cdot i_{t-1}$$

$$M_t = \phi(\bar{c}, i_t) = \bar{c} - 10 \cdot i_t$$

And thus $M_{t-1} = M_t$. Thus, money supply is unchanging and therefore seignorage revenue must be zero.

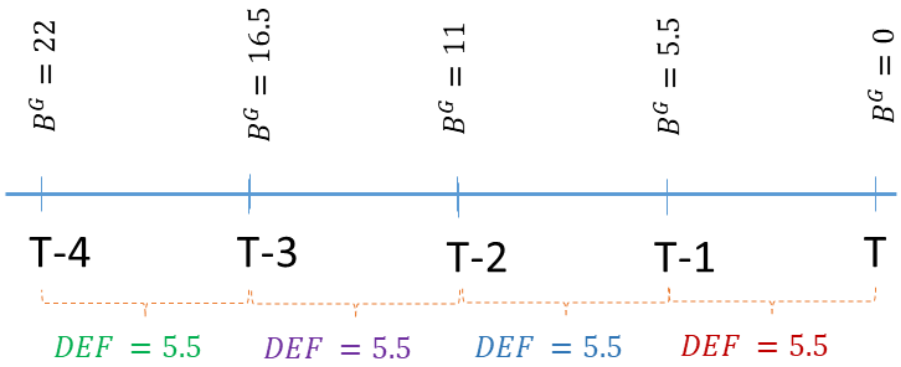
c) Recall the government budget constraint is $B^G_t - B^G_{t-1} = \frac{M_t - M_{t-1}}{E_t} - DEF_t$. Seignorage revenue is zero during this period, so the government budget constraint reduces to

$$B^G_t - B^G_{t-1} = -DEF_t$$

The left-hand side is the change in foreign reserves during period t, which is our definition of the balance of payments. That is, a country's BOP during a particular period equals the change in its foreign reserves during that period. With $DEF = 5.5$, clearly the BOP deficit is 5.5 every period.

d) With a completely unanticipated devaluation, the nominal interest rate will never rise therefore seignorage revenue will never become negative (that is, there will never be a currency run), so the only drain on foreign reserves is the fiscal deficit.

So, with a fiscal deficit of 5.5 and the government currently holding foreign reserves of 22, clearly it will take 4 periods for the government to run out of foreign reserves at which point the fixed exchange rate will have to be abandoned. *(see diagram below)*



Comment: *Please note that the scenario in lecture is that in the last period (which is from T-1 to T in the example above), the people will change expectation (or panic in some cases) and that causes the currency run. But in this part d, the assumption is different. The assumption is that the people "never expect…" thus, in this case, they do not change expectations. So from time T-1 to T. the depletion of foreign reserves only comes from DEF, 5.5.*
However, if the people "expect", then from time T-1 to T, the depletion will be higher than DEF or 5.5 (see lecture again and part f below).

e) Again use the interest parity condition. Now we have

$$E^e_{t+1} = (1+\mu)E_t = 1.5E_t,$$

so the interest parity condition becomes

$$1 + i = 1.1 \times 1.5$$

so the domestic nominal interest rate in the ***current period*** is $i = 0.65$ (before this period $i = 0.1$).

Intuition for why interest rate has to rise: The domestic nominal interest rate rises when the devaluation is imminent because in order to be induced to hold an asset denominated in a currency that is about to weaken investors have to be compensated with a higher return. (***Elaboration to help you understand better***: *Imagine you are an investor in this economy; your returns are denominated in this economy's currency and it is expected to be weakened. This means for the same amount of nominal profit you make, the real/effective profit will be lower. Thus in order to entice investors to continue to invest, interest rate needs to be higher.)*

f) FORMAL SOLUTION (ABRIDGED)

In the period before the exchange rate collapses, the nominal interest rate rises to 65 percent (computed in part e). Money demand in this period (plug into the given money demand function) is thus

$$\phi_t = E_t(11 - 10 \times 0.65) = 1 \cdot 4.5 = 4.5 \text{ (period of } \Delta \text{ in expectation)}$$

Next, compute money demand one period earlier: because the nominal interest rate was 10 percent one period earlier, money demand was

$$\phi_{t-1} = E_t(11 - 10 \times 0.10) = 1 \cdot 10 = 10$$

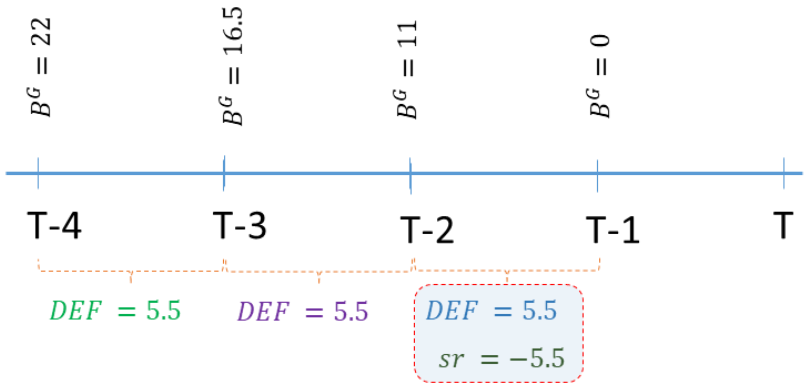
Thus, money demand (and hence the money supply) FALLS by 5.5. And thus, the seinorage revenue for this period is

$$\frac{\phi_t - \phi_{t-1}}{P_t} = \frac{4.5 - 10}{1} = -5.5$$

Intuition: The reason is a run on the currency – holders of the peso want to get out of pesos before the collapse of the exchange rate, so the money supply shrinks as citizens turn their pesos over to the central bank in exchange for dollars.

Thus, in this period (the balance of payments crisis) foreign reserves FALL by $5.5 + 5.5 = 11$ (5.5 due to the fiscal deficit plus 5.5 due to the negative seignorage revenue).

Thus the peg only lasts three periods now – at the end of period T-4 *(beginning of period T-3)*, foreign reserves are $22 - 5.5 = 16.5$, at the end of period T-3 *(beginning of period T-2),*, foreign reserves are $16.5 - 5.5 = 11$, and at the end of period T-2 *(beginning of period T-1)*, foreign reserves are $11 - 11 = 0$. (see diagram below)



ELABORATED SOLUTION

If you have difficulty understanding the formal solution, the following might be helpful for you to understand part f. (You are not expected to produce this long elaborated version. It is meant to enhance your understanding.)

The gist of this question: Find out when the change of expectation of foreign currency should occur. The change of expectation should only occur when the domestic currency holders suspect/*know* that the foreign reserves is low and if they do not act *on time*, their wealth may decrease due to devaluation of the domestic currency. On the other hand, if they know the government's reserve is still in good shape, why should they change the expectation? With this in mind, let's go through the steps to find out "how many periods"

Step 1: *In the period with the change in expectation (we don't know when it is yet),* the monetary situation is that of part e: $i_t = 0.65$

Step 2: *In the period with the change in expectation*, work out the money demand:

$$\frac{M_t}{P_t} = \phi(\bar{c}, i_t) = \bar{c} - 10 \cdot i_t$$
$$= 11 - 10 \cdot (0.65)$$
$$= 4.5$$
$$\Longrightarrow P_t\phi(\bar{c}, i_t) = E_t \cdot (4.5) = \bar{E} \cdot (4.5)$$

$(Note\ that\ this\ money\ demand\ is\ for\ the\ period\ when\ the\ expectation\ occurs$
$But\ when\ the\ expectation\ should\ occur\ is\ what\ we\ will\ find\ out)$

Step 3: To get the real seignorage revenue, we need to know the money demand in the previous period (*note: the change in expectation has not occurred in the previous period).* So the previous period's money demand is:

$$\frac{M_{t-1}}{P_{t-1}} = \phi(\bar{c}, i_{t-1}) = \bar{c} - 10 \cdot i_{t-1}$$
$$= 11 - 10 \cdot (0.10)$$
$$= 10$$
$$\Longrightarrow M_{t-1} = P_{t-1}\phi(\bar{c}, i_{t-1}) = E_{t-1} \cdot (10) = \bar{E} \cdot (10)$$

Step 4: So *in the period with the change in expectation*, the seinorage revenue is:

$$sr_t = \frac{M_t - M_{t-1}}{P_t} = \frac{4.5\bar{E} - 10\bar{E}}{\bar{E}} = -5.5$$

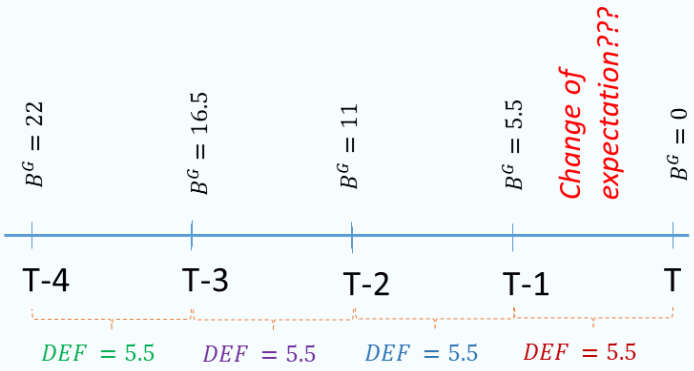
Intuition: Here, holders of domestic currency want to have a safer currency *before* the government runs out of foreign currency. They will sell domestic currency to central bank in exchange for foreign currency. ➔ money supply shrinks. That is why we have negative sr.

Step 5: **Thus**, *in the period with the change in expectation*, the depletion of foreign reserves comes from two sources - negative seignorage revenue and deficit. Thus the change in foreign reserves is:

$$B_t^G - B_{t-1}^G = sr_t - DEF_t = -5.5 - 5.5 = 11$$

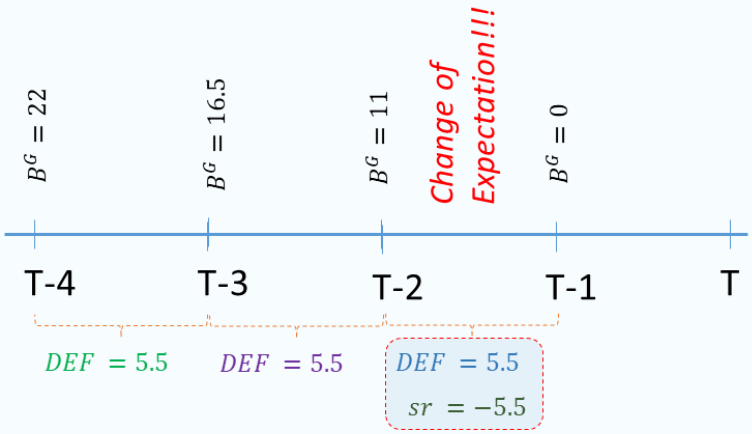
Step 6: So when will the change of expectation occur? Let's look at the two scenarios:

Scenario 1: if the expectation is formed in the 4th period as follow:



then it would be too late because the government is still having a $DEF = 5.5$ so the government will not have foreign reserves to sell to the domestic currency holders. Too bad!

Scenario 2: If the expectation occurs ONE period EARLIER, then the situation will be as follow:



In this scenario, the foreign reserves will be exactly zero (completely depleted) by the end of the 3rd period.

So comparing two scenarios, the domestic currency holders can work backward (backward induction) to know that they should change expectation according to Scenario 2. If they change their expectation according to Scenario 1, they will not be able to buy foreign currency from the CB.