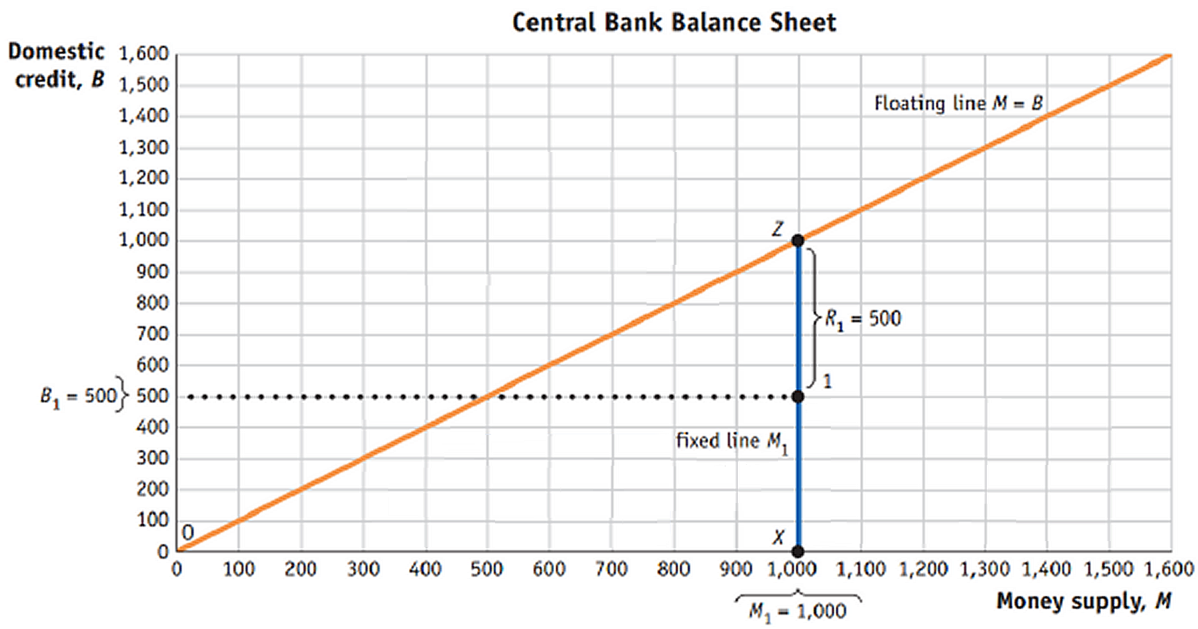
Problem 1

Explain how the following scenarios affect the central bank balance sheet diagram and home country's ability to maintain its exchange rate peg.

(a) Economic expansion leads to an increase in money demand.

(b) Currency traders suddenly expect a future appreciation in home currency.

Solution 1



Part a. An increase in Y increases money demand. When the money demand line shifts up, the interest rate increases and this implies an appreciation of home currency. So the central bank increases the supply of money to bring the interest rate back down to its original level, thereby bringing the exchange rate back up to its original level. They do this by purchasing foreign currency (thereby increasing their stock of reserves R) in exchange for domestic currency, which indeed increases the supply of home money in circulation. The fixed line therefore moves to the right and the central bank's position (still at $B_1 = 500$) is now further from the floating line — home country now has more ammunition to defend the exchange rate peg.

Part b. When E^e falls due to expected appreciation, the FR curve shifts down. This implies a lower E. To maintain the peg and raise E back up to its original level, the central bank should increase the money supply and lower the interest rate. They do this by purchasing foreign currency (thereby increasing their stock of reserves R) in exchange for domestic currency, which indeed increases the supply of home money in circulation. The fixed line therefore moves to the right and the central bank's position (still at $B_1 = 500$) is now further from the floating line — home country now has more ammunition to defend the exchange rate peg.

Problem 2

The government of the Republic of Banania is currently pegging the Bananian peso to the dollar at $E = 1$ peso per dollar. Assume the following.

In year 1, the money supply is $M = 12500$ pesos, reserves are $R = 4500$ pesos, and domestic credit is $B = 8000$ pesos. To finance spending, B is growing at 25 percent per year. Inflation is currently zero, prices are flexible, PPP holds at all times, and initially $P = 1$. Assume also that the foreign price level is $P^* = 1$, so PPP holds. The government will float the peso if and only if it runs out of reserves. The US nominal interest rate is $i = 5\%$. Real output is fixed at $Y = 12500$ at all times. Real money balances are initially $M/P = 12500 = L(i)Y$ when $i = 5\%$, and L is initially equal to 1. Assume myopia for parts (a) through (d).

(a) Assume that Bananian investors are myopic and do not forsee the reserves running out. Compute domestic credit in years 1, 2, 3, 4, and 5. At each date, also compute reserves, money supply, and the growth rate of money supply since the previous period (in percent).

(b) When do reserves run out? Call this time T. What will the new inflation rate be? What will the rate of depreciation be? What will be the new domestic interest rate?

(c) Suppose that at time T, when the home interest rate i jumps up, then $L(i)$ drops from 1 to 4/5. Recall that Y remains fixed. What is M/P before time T? What will be the new level of M/P after time T, once reserves have run out and inflation has started?

(d) At time T, what is the price level going to be right before reserves run out? What about when time T hits? What is the percentage increase in the price level? The exchange rate? (Use Part c and PPP.)

(e) Stop assuming myopia. Suppose investors know the rate at which domestic credit is growing. Given the above data, when do you think a speculative attack would occur? At what level of reserves will such an attack occur? Explain.

Solution 2

Part a. Year 1 is just what we're told, so

Year	B	R	M	μ
1	8000	4500	12500	–

- Year 2: B grows at 25%, so in year 2 we know we'll have $B = 8000(1.25) = 10000$. To maintain the peg, the central bank must hold M constant so that $\mu = 0$, and they do this by reducing R by 2000.

Year	B	R	M	μ
1	8000	4500	12500	–
2	10000	2500	12500	0

- Year 3: B grows to $10000(1.25) = 12500$. This means R must shrink by 2500 to maintain constant M. Oh hey, now reserves are zero so the peg has been destroyed. Great job, Banania.

Year	B	R	M	μ
1	8000	4500	12500	–
2	10000	2500	12500	0
3	12500	0	12500	0

- Year 4: Okay, now when B increases by 25%, and so must M, so $\mu = 25\%$. Reserves remain at zero. Therefore $B = M = 12500(1.25) = 15625$.

Year	B	R	M	μ
1	8000	4500	12500	–
2	10000	2500	12500	0
3	12500	0	12500	0
4	15625	0	15625	25%

- Year 5: And repeat. B and M increase to $15625(1.25) = 19531.25$, so $\mu = 25\%$. Reserves remain at zero.

Year	B	R	M	μ
1	8000	4500	12500	–
2	10000	2500	12500	0
3	12500	0	12500	0
4	15625	0	15625	25%
5	19531.25	0	19531.25	25%

Part b. As seen above, reserves run out in year $T = 3$. Then the nominal money supply instantaneously begins growing at 25%, so inflation instantaneously jumps to 25% and the rate of depreciation instantaneously jumps to 25% too. Inflation was initially zero when $i = 5\%$, implying that $r = 5\%$. But now we have non-zero inflation, so the nominal interest rate instantaneously jumps to $i = r + \pi = 5\% + 25\% = 30\%$. The change in i will have implications in the money market graph, as seen in the next part.

Part c. Before time T, we have $M = 12500$ and $P = 1$ so $M/P = 12500$.

Then because $R = 0$ at time T, we must have $M = B = PL(i)Y$. Plugging in what we know and are told about $T = 3$, we have

$$\frac{M}{P} = \frac{12500}{P} = \frac{4}{5} \times 12500 = 10000.$$

Alright, so the new equilibrium i as determined by the Fisher equation tells us that equilibrium real money demand — and therefore supply — instantaneously changes to 10000.

Part d. Before time T, the price level stays at $P = 1$ because the nominal money supply is unchanged; this means inflation is zero and the interest rate remains at $i = 5\%$ as given. But immediately as T hits, we know $M/P = 10000$ and we know that $M = 12500$ from parts b and c, from which it follows that $P = 1.25$. Therefore the increase in the price level is 25%. Recall that the exchange rate under PPP is $E_{H/F} = P_H/P_F$. There has been no change to P_F, but P_H has jumped by 25%, therefore $E_{H/F}$ must also jump by 25% so $E_{H/F} = 1.25$.

Okay, that's a lot to take in. It might help here to draw the money market graph, which is on the next page. I'll repeat the steps in bullet points to hopefully make each logical increment easier to digest.

- At time T, $M = 12500$ and $R = 0$, which means $B = M = 12500$.
- Because B is growing at 25%, it follows that M now growing at 25%, and therefore inflation instantaneously jumps from 0% to 25%.
- The Fisher equation says $i = r + \pi$. We went from $i = 5\% + 0\%$ to an instantaneously jump of $i = 5\% + 25\% = 30\%$.
- When the instantaneous jump in the interest rate causes $L(i)$ to drop to $4/5$, it means we're moving *along* the money demand function (because i is on the vertical axis of the money market graph) from point A (12500) to point B (10000).
- So there must be an instantaneous shift left of the real money supply to get to that new equilibrium $i = 30\%$. Well, we know that M is still 12500, so the only way there can be an instantaneous decrease in M/P is if P instantaneously jumps from 1 to 1.25. (Note that this change in P is distinct from inflation — inflation is a rate of change over time, whereas here the increase in P is an instantaneous, one-off jump.)

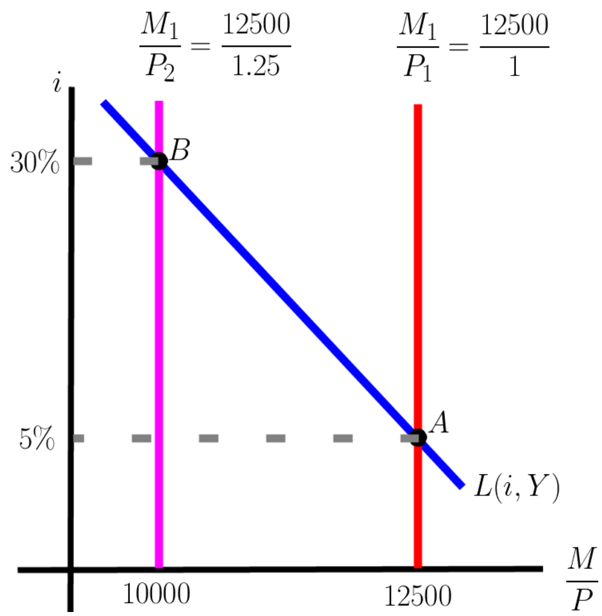


FIGURE 1: There is an increase in P to equilibrate real money supply with real money demand at the new (and sudden) interest rate of 30%.

This is unlikely to happen in practice, however. People who have pesos are likely to anticipate the expected depreciation and therefore will likely want to get rid of pesos in exchange for dollars before that happens. In this case, investors are forward-looking instead of myopic. Which leads to the next question...

Part e. The big problem with the previous problem is that there was a jump in the price level once reserves hit zero, which in turn caused the jump in the exchange rate. This jump in the price level was necessary because the real money supply M/P needed to fall to 10000 in order to equilibrate at $i = 30\%$, but M was fixed.

So what if speculators instead make M jump downwards via speculative attack? Then M/P can fall as needed with no jump in P and therefore no jump in E.

Let's look at year 2. The central bank has 2500 pesos worth of dollar reserves (which also happens to be 2500 dollars since the exchange rate is assumed to be $E = 1$). If speculators attack now and sell 2500 pesos to the central bank in exchange for 2500 dollars, then the peg is dead as $R = 0$.

- Then we have $M = B = 10000$ and $R = 0$.
- Because B is growing at 25%, it follows that M now growing at 25%, and therefore inflation instantaneously jumps from 0% to 25%.
- The Fisher equation says $i = r + \pi$. We went from $i = 5\% + 0\%$ to an instantaneously jump of $i = 5\% + 25\% = 30\%$.
- When the instantaneous jump in the interest rate causes $L(i)$ to drop to $4/5$, it means we're moving *along* the money demand function (because i is on the vertical axis of the money market graph) from point A (12500) to point B (10000).

- So there must be an instantaneous shift left of the real money supply to get to that new equilibrium $i = 30\%$. But wait, this time $M/P = 10000/1$ is already at the equilibrium level and therefore there is no need for P to change. Because P doesn't make a jump, it follows that E doesn't make a jump.

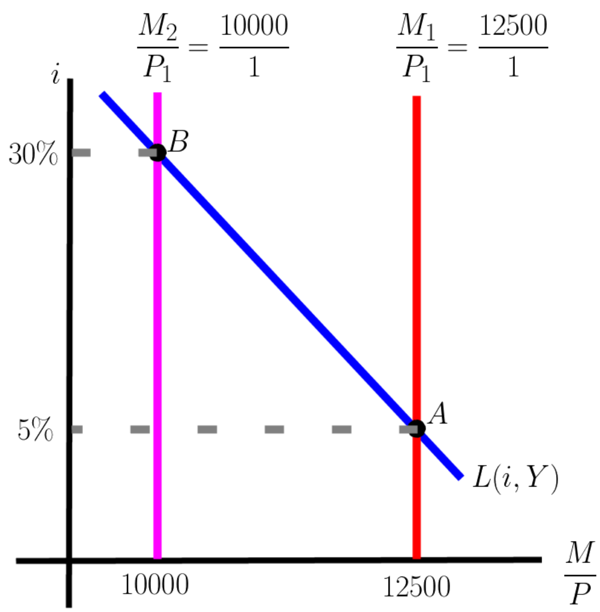


FIGURE 2: When the peg breaks, M/P will fall by 2500 no matter what. Peso holders can avoid a capital loss by draining the central bank's reserves exactly when $R = 2500$, which ensures that P and therefore E do not have to make any jumps.

In this case, *critical level* of reserves is $R_c = 2500$. The textbook gives a formula,

$$R_c = M(\phi \times \mu),$$

where ϕ is the responsiveness of money demand to changes in the interest rate: if i goes up by 1 percentage point, then M falls by ϕ percent. In other words, ϕ satisfies

$$\frac{\Delta M}{M} = -(\phi \times \Delta i).$$

Once reserves bottom out, we know that $\Delta i = \mu = 25\%$. And we are told that money demand falls from 1 to 4/5, so -20%. Ergo

$$-20\% = -(\phi \times 25\%) \quad \Longrightarrow \quad \phi = 0.80.$$

We also know that $M = 12500$. So plugging things in gives what we already know,

$$R_c = 12500(0.80 \times 0.25) = 2500.$$