Exercise Class 4

Solutions

BESS - FOUNDATIONS OF ECONOMICS - 30453

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Note: This document contains exercises relative to the program of Macroeconomics by Blanchard-Amighini-Giavazzi (ch. 19) and lecture notes. The program relies on the 3th edition of the book. Exercises are written by the author of the document or completely extrapolated from Ferraguto exercise textbook (5th edition).

Useful concepts

Marshall-Lerner Condition

In the open economy it is assumed that a depreciation of the domestic country's currency improves its current account. The condition that justifies this assumption is the Marshall-Lerner condition.

Take the net exports as shown in Blanchard and see what happens when a nominal appreciation/depreciation of the currency occurs.

$$NX = X(Y^*, \varepsilon) - \frac{1}{\varepsilon} IM(y, \varepsilon) \tag{1}$$

$$\frac{\partial NX}{\partial \varepsilon} = \frac{\partial X(y^*, \varepsilon)}{\partial \varepsilon} + \frac{1}{\varepsilon^2} IM(Y, \varepsilon) - \frac{1}{\varepsilon} \frac{\partial IM(Y, \varepsilon)}{\partial \varepsilon}$$

When there is equilibrium in trade balance, $NX = 0 \Rightarrow X(Y^*, \varepsilon) = IM(Y, \varepsilon)$. Without loss of generality, we can assume we are in the situation of zero net trade balance. Substituting above and multiplying both sides by $\frac{\varepsilon}{X}$, we obtain:

$$\frac{\partial NX}{\partial \varepsilon} \frac{\varepsilon}{X} = \frac{\partial X(y^*, \varepsilon)}{\partial \varepsilon} \frac{\varepsilon}{X} + \frac{1}{\varepsilon^2} IM(Y, \varepsilon) \frac{\varepsilon}{X} - \frac{1}{\varepsilon} \frac{\partial IM(Y, \varepsilon)}{\partial \varepsilon} \frac{\varepsilon}{X}$$

$$\frac{\partial NX}{\partial \varepsilon} \frac{\varepsilon}{X} = \frac{\partial X(y^*, \varepsilon)}{\partial \varepsilon} \frac{\varepsilon}{X} + \frac{IM(Y, \varepsilon)}{IM(Y, \varepsilon)} - \frac{\partial IM(Y, \varepsilon)}{\partial \varepsilon} \frac{\varepsilon}{IM(Y, \varepsilon)}$$

$$\frac{\partial NX}{\partial \varepsilon} \frac{\varepsilon}{X} = \eta_X - \eta_{IM} + 1 \tag{2}$$

Where η_X and η_{IM} is the elasticity of exports and imports with respect to nominal exchange rate, respectively.

As a result, the Marshall-Lerner condition states that when there is an initial situation of equilibrium in the trade balance, a real domestic currency **depreciation** has a **positive effect on net exports** if the RHS of equation (2) is greater than zero, or that the sum of relative price elasticities of export and import demand exceeds one.

$$\eta_X - \eta_{IM} + 1 > 0$$

$$\eta_{IM} - \eta_X > 1$$

M-L implication on the IS market

When openness is introduced in the goods market, the IS equation takes the following form:

$$Y = C(Y - T) + I(Y, r) + G + NX(Y, Y^*, \varepsilon) \tag{3}$$

Where $NX(Y, Y^*, \varepsilon) = X(Y^*, \varepsilon) - \frac{1}{\varepsilon} IM(Y, \varepsilon)$. How can we determine the sign relationship between the NX and the variables it depends from? The answer is: through the Marshall-Lerner condition.

Indeed, assuming a real depreciation has a positive impact on net exports, we can claim that net exports depend positively on foreign output, negatively on domestic output (since increase in Y increases imports) and negatively on the real exchange rate (appreciation has negative impact on NX due to M-L).

$$Y = C(Y - T) + I(Y, r) + G + \underset{(-),(+),(-)}{NX(Y, Y^*, \varepsilon)}$$

Introducing the money market

When we introduce the money market, we have to keep in mind that the relationship among interest rates of different countries matters. This relationship, as you already know, in an open economy is determined by the Uncovered Interest Parity condition (look at Ex.3 of section 2 in the Exercise Class 3).

The system of equations we have to face now is therefore given by (1) the IS market equation, (2) the LM market equation, (3) the UIP that establish a connection between exchange and interest rates.

$$IS: \quad Y = C(Y - T) + I(Y, r) + G + NX(Y, Y^*, \varepsilon) \tag{4}$$

$$LM: \quad i = \bar{i} \tag{5}$$

$$UIP: \quad (1 + i_t) = (i + i_t^*)\frac{E_t}{E_{t+1}^e} \tag{6}$$

Now we are ready to start exercises.

Ch.19 - Output, the interest rate and the exchange rate

Exercise 1

(a) Look at the last equations of the previous section. Assume the following:

1. The future expected interest rate is exogenously determined and fixed in the model. Rewrite the UIP.

2. There is no inflation, so that $\pi^e = 0 \Rightarrow r = i$.

3. The ratio of domestic and foreign price is equal to 1, $\frac{P}{P^*} = 1$.

Rewrite equations (4),(5),(6).

Solution

$$IS: \qquad Y = C(Y-T) + I(Y,i) + G + NX(Y, Y^*, E) \tag{7}$$

$$LM: \qquad i = \bar{i} \tag{8}$$

$$UIP: \qquad (1+i) = (i+i^*)\frac{E}{\bar{E}^e} \tag{9}$$

(b) Rewrite the IS-LM model substituting the UIP into the IS equation.

Solution From the new version of UIP, we can derive the nominal exchange rate:

$$E = \frac{1+i}{1+i^*}\bar{E}^e$$

And the final form of IS-LM is:

$$IS: \qquad Y = C(Y-T) + I(Y,i) + G + NX(Y, Y^*, \frac{1+i}{1+i^*}\bar{E}^e)$$

$$LM: \qquad i = \bar{i}$$

(c) Represent in 2 graphs the IS-LM and UIP relation occurring in an open economy.

Exercise 2

Consider an Asian country that trades freely goods and services with the rest of Asia, operating under a flexible exchange rate regime with perfect capital mobility, and its economy system can be described by the standard open-economy IS-LM model. Suppose that both the domestic and foreign price levels are fixed (so that $\pi = \pi^e = 0$), and that the Marshall-Lerner condition is satisfied.

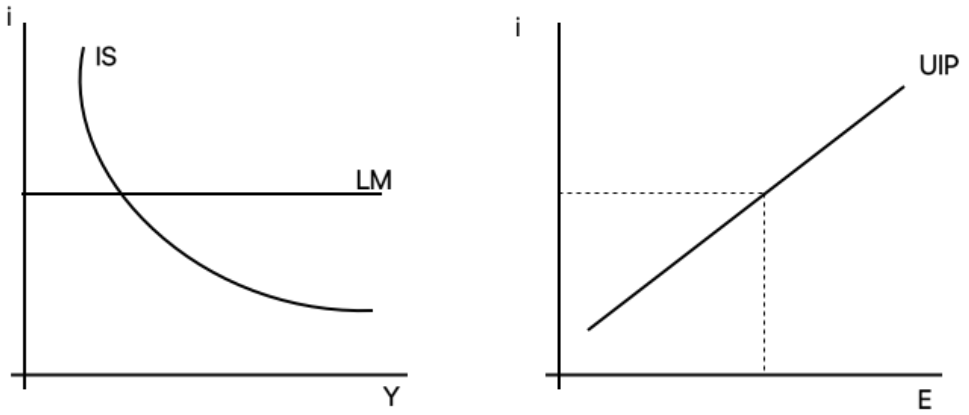

Figure 1: IS-LM and UIP relationship

(a) For unknown reasons, the domestic Central Bank decreases i. Describe what happens to the equilibrium output level, the real exchange rate, the nominal exchange rate, and the composition of GDP. Represent in a graphs the equilibrium before and after the change in i.

Take as usual the equations involved in the model and see which of them is affected by the change of the variable. Then draw them in a graph and explain what happens economically.

Solution

$$IS: \qquad Y = C(Y-T) + I(Y,i) + G + NX(Y, Y^*, \frac{1+i}{1+i^*}\bar{E}^e)$$

$$LM: \qquad i = \bar{i}$$

The LM curve shifts down, due to a lower level of interest rate. As a consequence, interest rate change affects both the level of investment (which tends to increase since the cost of financing is lower) and the level of nominal exchange rate E, which decreases. Economically, the lower interest rate set by the central bank has mainly two effects: (1) it reduces the cost of financing, hence increases investments, which has a positive

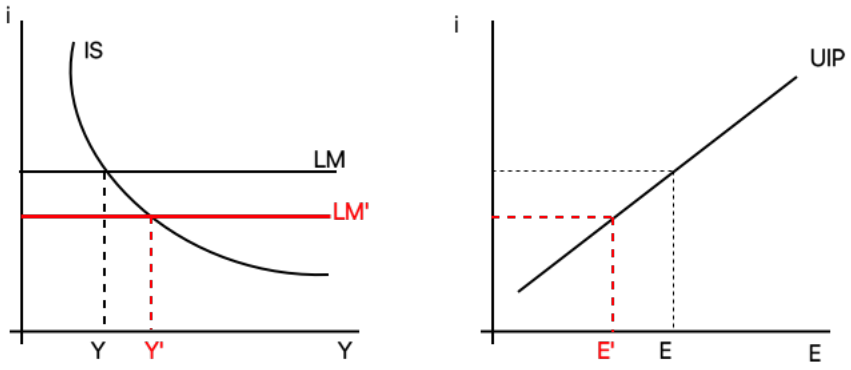

Figure 2: Change of interest rate effect on IS-LM-UIP.

impact on the level of output; (2) the lower interest rate reduces the level of exchange rate, which depreciates with respect to foreign currencies, making domestic goods more attractive (remember: the level of exchange rate is negatively related to net exports when the M-L holds, hence the depreciation of domestic currency push upwards the level of net exports). As a result, even this effect contributes the higher overall level of output.

(b) Suppose now that the domestic Government decided to bring output back to its initial level, using only the tax instrument. Describe the policy that the Government has to implement in order to achieve its goal. What are the final effects on the interest rate, the real exchange rate, the nominal exchange rate, and the composition of GDP?

Solution If the only instrument in government hands is taxation, in order to bring back the level of overall output, the government need to increase taxes. Higher taxes has a negative effect on output, shifting the IS curve to the left; the IS equation is the only one interested in the change. Nothing happens to the LM (nor the UIP).

$$IS: \qquad Y = C(Y - T) + I(Y, i) + G + NX(Y, Y^*, \frac{1+i}{1+i^*}\bar{E}^e)$$

$$LM: \qquad i = \bar{i}$$

From the graph you can see the shift in IS causes a reduction in the level of output, while the UIP is not touched. Finally, economically: the increase in taxation depresses

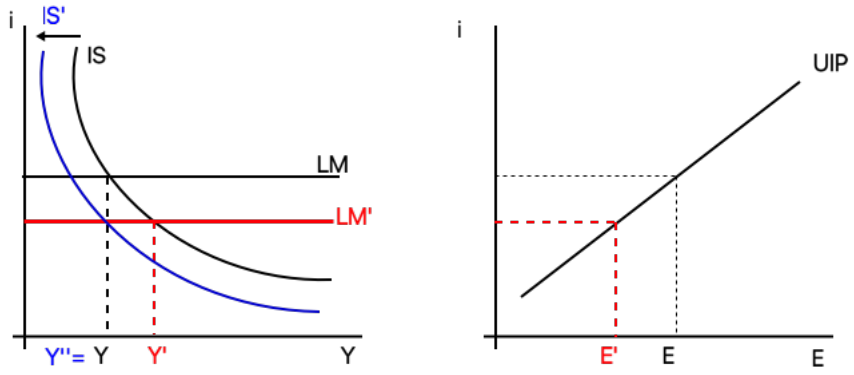

Figure 3: Effects of a change in taxes.

disposable income and in turn consumption. Output falls due to a reduction in internal demand, and net exports rise due to a reduced level of imports. Nothing happens on the parity side, since the overall level of the interest rate is left unaltered.

Exercise 3

(a) Describe what happens to monetary policy when the exchange rate is fixed (derive the new UIP condition) and there is perfect capital mobility.

Solution When the exchange rate is fixed, it is assumed that the the rate is pegged at a given fixed value $\bar{E}$. At the same time, agents expectations in the future expect that the rate will be fixed as well. There is no reason to think it's going to become flexible (despite extraordinary situations). Therefore, also $E^e_{t+1} = \bar{E}$. This implies that the UIP takes the following form:

$$
\begin{aligned}
UIP: \qquad (1 + i_t) &= (i + i^*_t)\frac{\bar{E}}{\bar{E}} \\
(1 + i_t) &= (i + i^*_t) \\
i_t &= i^*_t
\end{aligned}
$$

As a result, the domestic interest rate takes the value of the foreign interest rate, making the domestic monetary policy (through variations in domestic interest rate level), ineffective.

(b) Explain the difference among **depreciation** and **devaluation**.

Solution Depreciation (of domestic currency) is a reduction of the price of the domestic currency with respect to the foreign one. The devaluation is the same concept applied to fixed exchange rate regimes. Similarly, this difference applies to appreciation/revaluation.
Remind that devaluations and revaluations tend to happen rarely, due to the nature of the exchange rate regime.

Exercise 4 - Q18, pg. 174 Ferraguto

Consider an open economy under **fixed exchange rate** regime. Domestic and foreign prices are constant ($P = P^* = 1$). In the IS-LM-UIP graphs show the initial equilibrium (i, Y, E), i.e. the associated values of the interest rate, output and exchange rate. Initially market participants expect that exchange rate will be kept fixed at the current level E also in the future, so that $E' = E$.
Note: here we are relaxing the assumption of an exogenously given future exchange rate (point a.1 exercise 1). The future exchange rate is endogenous in the model and not predetermined.

(a) Suppose that the central bank announces a devaluation of the currency, it announces that, effective immediately, the value at which the exchange rate is kept fixed is lowered to $E' < E$. In addition, assume that individuals, who not did expect this announcement, revise accordingly the value of the **expected** exchange rate they expect to prevail in the future, so that now $E^{e'} = E'$. Analyse it in a graph and explain the effects of the devaluation on domestic output, interest rate and money supply.

Solution Note first that the UIP takes the usual form if the exchange rate is expected to change as in this case, so we have the usual UIP relationship used in flexible regime

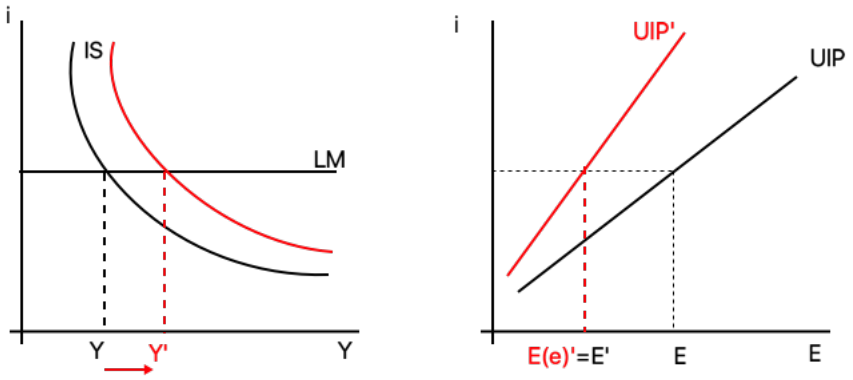

Figure 4: Effect of devaluation on output and (expected) exchange rate.

(but for the future exchange rate which is not fixed anymore).

$$IS: \qquad Y = C(Y-T) + I(Y,i) + G + NX(Y, Y^*, \frac{1+i}{1+i^*}E^e)$$

$$LM: \qquad i = \bar{i}$$

As already discussed above, net exports are decreasing in E. The devaluation of current exchange rate reflects a decrease in the future exchange rate, which pushes up the level of net exports.

$$\frac{\partial NX}{\partial E'} < 0$$

On the UIP side, the curve rotates to the left having an overall higher inclination, due to the effect of current and expected exchange rate.

$$\frac{\partial i}{\partial E^e} = -\frac{(1+i^*)E}{(E^e)^2} < 0$$

The overall level of output is higher since foreign buyers are attracted by cheaper domestic goods and increase their purchases.

$$\frac{\partial Y}{\partial NX} => 0$$

Graphically, what we obtain is the following: The economic reasoning behind, as already anticipated works as follows: the announcement of devaluation in the fixed exchange

rate regime makes the expected exchange rate align to the new actual rate. The new equilibrium level on the UIP will be composed of a lower rate and the same level of interest rate, which remains equal to the foreign one (as it was before the change).
Net exports rise as an effect of more attractive domestic goods for foreigners (real price is lower due to the devaluated exchange rate).
On the goods market, the IS curve shifts right, due to higher net exports, leading to a higher level of output.

(b) Suppose that before the devaluation, both domestic and foreign country were in a medium-run equilibrium, with income at its natural level and zero inflation. In addition, assume that the inflation rate is determined according to the following Phillips curve:

$$\pi = \frac{\alpha}{L}(Y - Y_n)$$

Once price adjustment, as implied by the previous equation, is taken into account, do you think that a devaluation can permanently affect the level of income of a country? (no formal analysis required, just describe the dynamic adjustment dynamic of the economy following a devaluation.)

Solution The devaluation has risen output, at a level above its natural one. As a result, from the Phillips curve above, you can see that the inflation from zero level becomes positive. In other words, domestic prices will start to increase and since the foreign price remain at the previous level as before, the currency start to appreciate, making domestic goods less competitive and revert back the initial (point (a)) effect.
In the medium-run the equilibrium output will be back to its natural level together with the real exchange rate (increased again through the price channel).

Monetary Policy

Exercise 1 - Corridor and Floor Systems

Explain the main difference between the corridor and floor system in monetary policy implementation.

Solution In the **corridor** system, the amount of reserves is fixed by the Central Bank and the banking system cannot change it. The fixed reserves supply in the system meets the demand in what is called the "target rate". The target rate fluctuates between the deposit and lending rates, set again by the Central Bank. The level of the target rate can be changed by shifting the demand curve, i.e. setting different levels for lending and deposit rate. In this way, the stance of monetary policy can change even if reserves are not affected at all.
As for the the **floor-system**, to avoid dependence between monetary policy stance and the amount of reserves, reserves are offered in excess in the system. As a result, the target rate coincides with the deposit rate (i.e. the floor rate) and the equilibrium interest rate does not depend on quantity of reserves supplied.
The floor system allows the Central Bank to change the monetary policy stance (rates level) without affecting the liquidity in the banking system.

Exercise 2 - True or False

Claim if the following statement is true or false.
Changes in the stance of monetary policy can only be achieved by affecting the supply of central bank reserves.

Solution False. In a "corridor" system, the stance of monetary policy can be effectively changed by simply shifting the demand for reserves, i.e. by changing the lending and deposit rate in a symmetric fashion. This allows the CB to change the interest rate without affecting the amount of reserves in the system. Of course, this is also true in a "floor" system, where the reserves are in excess supply and intersect the demand curve in its flat part.

Exercise 3 - ECB Policies (extra)

Visit the ECB website to answer to the following questions.

1. Which are the main rates set by the ECB?
2. What is the name of the unconventional monetary policy (on the reserves side) set by the ECB after the 2007/8 crisis?

3. What is the "APP" and what is meant by "capital keys"? How does the APP affect reserves?

4. What is the main difference in the purchase programmes held after 2015 and the new one implemented to face COVID crisis?