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Problem Set III: Solution

EE212 — Principles of Macroeconomics

Semester 2/2019-2020

Total mark: 20 points

Due date: Friday 17 April 2020 **before midnight** to jenmana@econ.tu.ac.th.

Any late submission **will not** be graded.

Please submit in pdf form, and not word document.

Dear students,

Two weeks are given to complete this assignment. As mentioned, we will have four problem sets, each making up 7.5% of your total grade (30% in total). These will be challenging, and will demand you to revisit the topics that have been mentioned so far in class, as well as to read the mandatory readings.

Reminder on academic policy: I encourage you all to work together and exchange ideas out of class. However, I also encourage you all as university scholars to start independently critically approach a topic, a question, or a challenge that will be posed in this class, as well as the future ones.

I expect your independent completion of the short essays, as it would be obvious if they are not your own ideas. Plagiarism and cheating will be treated with disciplinary actions. Thammasat University, our faculty, and I take academic integrity extremely seriously.

Problem I: short answers and the right blend of policies (5 points)

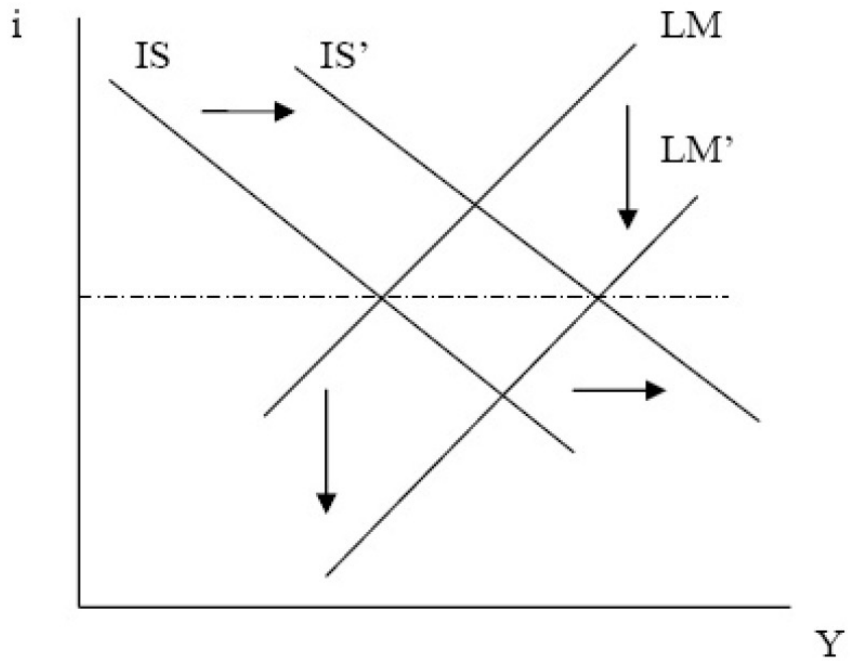
1. *True or false?* The Bank of Thailand *cannot* set the real interest rate below zero due to the zero lower-bound problem. Explain your reasoning. (1 point)

   Answer:

   False! The Bank of Thailand can try to set the real interest rate **only through the nominal interest rates**. However, in some cases – such as the lower bound problem – we can have low or close to zero equilibrium nominal interest rates. If inflation happens to be high, then we can have the real interest rate below zero – but this tends to be out of the BoT's power to decide.

   For the next two questions, let's assume that the economy is at the equilibrium (Y^*, i^*). Using the IS-LM model, (1) suggest a mix of policy that would satisfy each of the objectives, (2) draw the IS-LM diagram which shows the proposed mix of policies, and (3) discuss what are the changes to C, I, and G.

2. "Increasing aggregate income while keeping interest rate constant" (2 points)

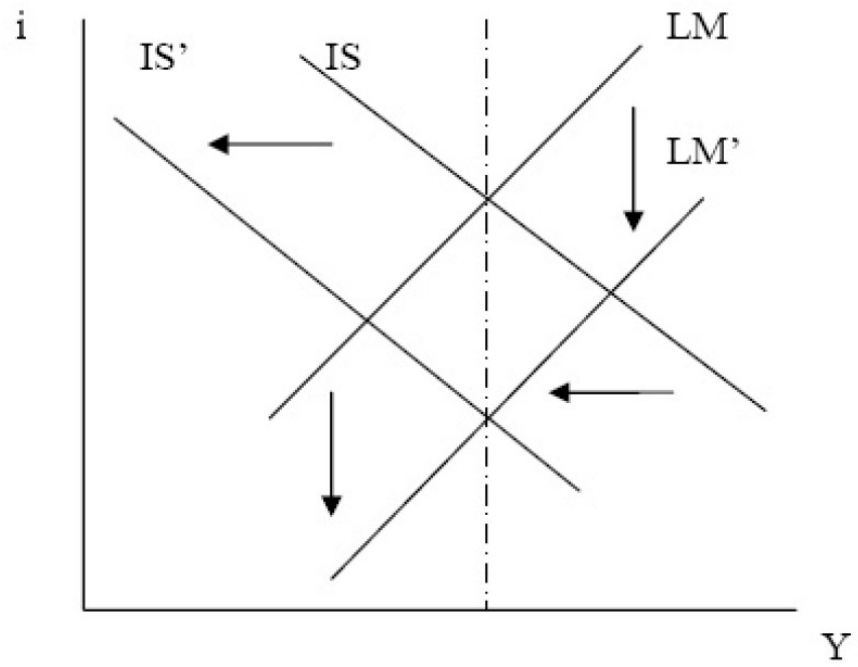


   Answer:

   the only right combination is a mix of expansionary fiscal & expansionary monetary policies. The fiscal policy ($G \Uparrow$) will lead to a higher level of output, but higher level of equilibrium interest rate. In order to keep the level of interest rate at the same level, the Bank of Thailand should increase the nominal money supply, shifting the LM curve downward (lower i for each level of Y).

   Thus, since Y increases, C increases ($C = c_0 + c_1 Y_d$). I stays at the same level since the cost of borrowing stays the same.

3. "Improving budget balance $(T - G)$ while keeping Y constant" (2 points)



Answer:

Improving budget balance literally means a contractionary fiscal policy (through $T \Uparrow$ or $G \Downarrow$). This will lead to both lower i^* and Y^*. In order to restore the same level of aggregate output, the Bank of Thailand should commit to an expansionary monetary policy until the original equilibrium aggregate output is reached. This will lead to an even lower level of nominal interest rate.

Thus, $G \Downarrow$, consumption does not change (Y does not change), while $I \Uparrow$.

Problem II: the IS-LM model (10 points)

Here is a tip for finding equilibriums. Mathematically, we know that we have found the equilibrium when we have successfully characterised the relation with only exogenous variables. That is, if we are to characterise the equilibrium output, Y^* – if you have noticed – at the end everything must not be in relation to other endogenous variables (for instance, in this case, the interest rate i^*.

Let the economy be characterised by:

$$\begin{aligned} Y &= C(Y,T) + I(Y,i) + G \\ C &= c_0 + c_1 Y_d \\ I &= b_0 + b_1 Y - b_2 i \\ \left(\frac{M}{P}\right)^d &= d_1 Y - d_2 i \\ \left(\frac{M}{P}\right)^s &= \frac{M}{P} \end{aligned}$$

Where $\left(\frac{M}{P}\right)^d$ is the aggregate money demand and $\left(\frac{M}{P}\right)^s$ the real money supply. $(b_1 + c_1) < 1$ and G, T, and M are exogenously given and constant.

1. Derive the IS function. What is the slope of the IS curve? What is $\frac{dY}{di}$? What is the sign of the slope? Write about the two components that influences the steepness of the IS curve. (1 point)

   Tips: do note that $\frac{dY}{di}$ is not the slope of the IS curve since Y is on the horizontal axis, and i is the vertical axis.

   Answer: The IS function is simply the Keynesian cross. It is where the aggregate supply denoted simply by Y equates the aggregate demand in the goods market.

$$\begin{aligned} Y^* &= C + I + G \\ &= c_0 + c_1(Y^* - T) + b_0 + b_1 Y^* - b_2 i + G \\ \Rightarrow Y^* &= \frac{1}{1 - c_1 - b_1}(c_0 - c_1 T + b_0 - b_2 i + G) \\ \frac{\partial Y}{\partial i} &= -\frac{b_2}{1 - c_1 - b_1} < 0 \\ \text{The slope of the IS relation} &= -\frac{1 - c_1 - b_1}{b_2} \end{aligned}$$

   The slope is negative since $1 - c_1 - b_1 > 0$ and $b_2 > 0$. There are two components: (i) the Keynesian multiplier $(1 - c_1 - b_1)$; and (ii) the interest rate elasticity of investment (b_2).

   If b_2, the interest rate elasticity of investment, is higher, the IS curve becomes flatter since now small changes in interest rates will lead to higher change in Y^* (through higher investment). Meanwhile, if the Keynesian multiplier is higher, it means that the IS curve is steeper. This means that interest rate will comparatively lead to the lower change in Y since in general, the effect of interest rate is now dominated by the effect of the multiplier.

2. Derive the LM function. What is the slope of the LM curve? The sign of the slope? Discuss what determines the steepness of the LM curve. (1 point)

   Answer: The LM function can be given by all the equilibrium points in the money market – where the money supply equates the money demand.

$$\begin{aligned} \frac{M}{P} &= d_1 Y^* - d_2 i^* \\ \Rightarrow i^* &= \frac{d_1}{d_2} Y^* - \frac{1}{d_2}\frac{M}{P} \end{aligned}$$

The slope of the LM relation is then $\frac{d_1}{d_2}$ which is clearly positive – since if aggregate increases the money demand will shift to the right, leading to a higher equilibrium interest rate – *ceteris paribus.* There are two factors determining the steepness of the curve: (i) d_1, the income elasticity of money demand; and (ii) d_2 the interest rate elasticity of money demand.

If d_1 increases, it means that equilibrium interest rate is very sensitive to aggregate income changes – thus the LM curve will be steeper. Meanwhile, if d_2 increase, the LM curve will be flatter from the fact that speculative money demand is very sensitive to changes in the interest rate.

3. Plot the equilibrium output and the equilibrium interest rate with proper labels for the IS and the LM relations, as well as the axis. *No need to solve for the equilibrium Y^* and i^* – just show them on the figure.* (1 point)

   Answer: see class lectures.

4. Now, let's assume, based on the quantity theory of money, that the money demand is independent of interest rates:

$$\left(\frac{M}{P}\right)^d = d_1 Y$$

   (4.1) What does the money demand and the LM curve looks like? (1 point)

   The aggregate money demand curve and the LM curve is vertical !

   (4.2) Solve for the equilibrium output and the equilibrium interest rate. (1 point)

   The LM equation is given by:

$$\begin{aligned} \frac{M}{P} &= d_1 Y^* \\ \Rightarrow Y^* &= \frac{1}{d_1}\frac{M}{P} \end{aligned} \tag{1}$$

   Our IS relation is:

$$\begin{aligned} Y^* &= \frac{1}{1-c_1-b_1}\left(c_0 - c_1 T + b_0 - b_2 i^* + G\right) \\ i^* &= -\frac{1-c_1-b_1}{b_2} Y^* + \frac{1}{b_2}\left(c_0 - c_1 T + b_0 + G\right) \end{aligned}$$

   replacing Y^* by equilibrium condition using (1)

$$\Rightarrow i^* = -\frac{1-c_1-b_1}{b_2 d_1}\frac{M}{P} + \frac{1}{b_2}\left(c_0 - c_1 T + b_0 + G\right) \tag{2}$$

   (4.3) How does output reacts to changes in taxation, T? (1 point)

   Answer: If money demand does not depend on interest rate, **output does not respond to change in fiscal policy! – see equation (1)**

5. Now let's assume that the money demand is independent of aggregate output – meaning that the LM curve is horizontal

$$\left(\frac{M}{P}\right)^d = d_1 - d_2 i$$

(5.1) Solve for the equilibrium output and the equilibrium interest rate. (1 point)

Answer: Our LM relation is given by:

$$\begin{aligned} \frac{M}{P} &= d_1 - d_2 i \\ \Rightarrow i^* &= \frac{d_1}{d_2} - \frac{1}{d_2}\frac{M}{P} \end{aligned} \tag{3}$$

Our IS relation, the equilibrium in the goods market, is given by :

$$Y^* = \frac{1}{1 - c_1 - b_1}\left(c_0 - c_1 T + b_0 - b_2 i^* + G\right)$$

replacing i^* by equilibrium condition using (3)

$$\Rightarrow Y^* = \frac{1}{1 - c_1 - b_1}\left(c_0 - c_1 T + b_0 - b_2\left(\frac{d_1}{d_2} - \frac{1}{d_2}\frac{M}{P}\right) + G\right) \tag{4}$$

(5.2) How does output reacts to changes in taxation, T? (1 point)

Answer: Equilibrium aggregate output will change by $-\frac{c_1}{1-c_1-b_1}$ when T changes by one unit. That is:

$$\frac{\partial Y^*}{\partial T} = -\frac{c_1}{1 - c_1 - b_1}$$

(5.3) Comparing the answers from (3.3) and (4.2), what can you say about the differences? (2 points)

We can conclude that the steepness of the LM curve will determine the effectiveness of fiscal policy. In the case that LM curve is vertical (very steep), the equilibrium output is not affected at all by T or G (see equation 1). Meanwhile, if the LM curve is horizontal (very flat), the effect is comparatively higher.