

Exercise 6

IS-LM Model

1. The IS-LM Model is a general equilibrium model, which means that...analyze 2 markets at the same time.....
 There are...2...markets, which are...the goods and services market and the money market.
 The price that clears these markets is...the interest rate.....
 The IS curve represents a...negative...relationship between
i.....and.....Y.....This is because.....higher interest rates...
 ...reduce in investment.....
 The LM curve represents a...positive...relationship between
i.....and.....Y.....This is because.....when income is.....
 ...low, interest rate is low.....
 Each point on the IS curve is an equilibrium in the.....market.
 Therefore, we have the equilibrium condition: $Y = AE$
 Each point on the LM curve is an equilibrium in the...money...market.
 Therefore, we have the equilibrium condition: $M_s = M_d$

2. Ceteris Paribus (other things equal), how will each variable affect each curve – shift (to which direction?) or movement?

Variable	IS Curve	LM Curve
$i \uparrow$	<u>movement</u>	<u>movement</u>
$G \downarrow$	<u>shift to the left</u>	
$T \downarrow$	<u>shift to the right</u>	
$G \& T \uparrow$ equally	<u>shift to the right</u>	
$M \downarrow$		<u>shift to the left</u>
$P \downarrow$		<u>shift to the right</u>

3. Explain, together with diagrams, how we can derive the IS curve from Keynesian Cross, and how we can derive the LM curve from the money market.

4. Assume a closed economy with the government. The economy has the following parameters:

$$C = C_0 + C_1(Y - T) \quad I = I_0 - I_1 \cdot i \quad G = G_0 \quad T = T_0$$

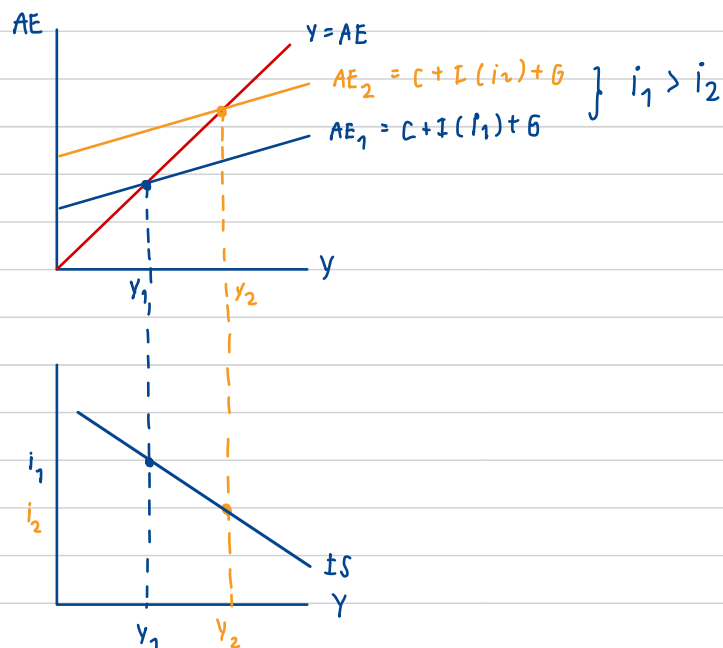
$$L(i, Y) = L_Y \cdot Y - L_i \cdot i \quad M = M_0 \quad P = P_0$$

Answer the following questions.

- 4.1 What are I_1 , L_Y , and L_i ?
 4.2 Why are I_1 and L_i negative?
 4.3 Derive the IS equation that shows how i and Y are related.

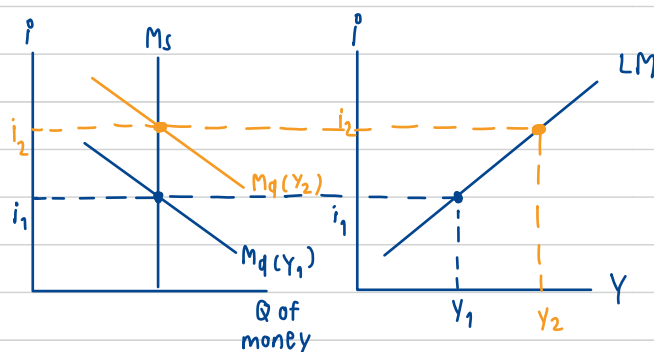
3. Explain, together with diagrams, how we can derive the IS curve from Keynesian Cross, and how we can derive the LM curve from the money market.

IS curve



When the interest rate decreases, investment increases. Then, AE will increase and Y will increase. This means that lower interest rates lead to increase in Y. ($i \downarrow \rightarrow I \uparrow \rightarrow AE \uparrow \rightarrow Y \uparrow$)

LM curve



$$\begin{array}{lcl}
 M_s = M_d & Y \uparrow \rightarrow M_d \uparrow & \\
 \frac{M}{P} = L(Y, i) & i \uparrow \rightarrow M_d \downarrow & \left. \vphantom{\begin{array}{l} Y \uparrow \rightarrow M_d \uparrow \\ i \uparrow \rightarrow M_d \downarrow \end{array}} \right\} M_s = M_d
 \end{array}$$

When Y changes, interest rates also need to change in order to control the equilibrium.

4. Assume a closed economy with the government. The economy has the following parameters:

$$C = C_0 + C_1(Y - T) \quad I = I_0 - I_1 \cdot i \quad G = G_0 \quad T = T_0$$

$$L(i, Y) = L_Y \cdot Y - L_i \cdot i \quad M = M_0 \quad P = P_0$$

Answer the following questions.

- 4.1 What are I_1 , L_Y , and L_i ?
 4.2 Why are I_1 and L_i negative?
 4.3 Derive the IS equation that shows how i and Y are related.
 (Hint: Start with the equilibrium condition $Y = AE$. Then, substitute relevant variables into the expression. Lastly, rearrange i to the LHS and everything else on the RHS.)
 4.4 Find the slope of the IS curve.
 (Hint: The coefficient before Y is the slope of IS.)
 4.5 Derive the LM equation that shows how i and Y are related.
 (Hint: Start with the equilibrium condition $M_d = M_s$. Then, substitute relevant variables into the expression. Lastly, rearrange i to the LHS and everything else on the RHS.)
 4.6 Find the slope of the LM curve.
 (Hint: The coefficient before Y is the slope of LM.)

4.1) I_1 = sensitivity of investment to changes in interest rate
 L_Y = sensitivity of M_d to changes in Y
 L_i = sensitivity of M_d to changes in i

4.2) Because when $P \uparrow$, people don't want to hold money.

4.3) $Y = AE$
 $Y = C + I + G$
 $Y = C_0 + C_1(Y - T_0) + I_0 - I_1 \cdot i + G_0$
 $Y = C_0 + C_1 Y - C_1 T_0 + I_0 - I_1 \cdot i + G_0$
 $(1 - C_1)Y = (C_0 - C_1 T_0 + I_0 + G_0) - I_1 \cdot i$
 $i = \left(\frac{1}{I_1}\right) (C_0 - C_1 T_0 + I_0 + G_0) - (1 - C_1)Y$

4.4) $Y = \left(\frac{1}{1 - C_1}\right) (C_0 - C_1 T_0 + I_0 + G_0) - I_1 \cdot i$

4.5) $M_s = M_d$
 $\frac{M}{P} = L(i, Y)$
 $\frac{M_0}{P_0} = L_Y \cdot Y - L_i \cdot i$
 $i = \left(\frac{1}{L_i}\right) \left(-\frac{M_0}{P_0}\right) + L_Y \cdot Y$

4.6) $Y = \left(\frac{1}{L_Y}\right) \left(\frac{M_0}{P_0}\right) + L_i \cdot i$

5. From Question 4.4, we can see that the slope of IS curve depends on two factors. Explain how each of these factors affects the slope of the IS curve. We also can see that the slope of LM curve depends on two factors. Explain how each of these factors affects the slope of the LM curve.

The slope of IS curve depends on the sensitivity of investment to changes in interest rate and the multiplier.

- ① If the investment is sensitive to interest rate, interest rate will decrease and that can cause a large increase in output. This means IS will be flat.

$$i \downarrow \rightarrow I \uparrow_{\text{a lot}} \rightarrow AE \uparrow_{\text{a lot}} \rightarrow Y \uparrow_{\text{a lot}}$$

- ② Large investment multipliers lead to the increase in investment and then a large increase in output. This means IS will be flat.

$$i \downarrow \rightarrow I \uparrow \rightarrow AE \uparrow_{\text{a lot}} \rightarrow Y \uparrow_{\text{a lot}}$$

The slope of LM curve depends on L_Y and L_i .

- ① Large L_Y lead to large increases in M_d . This means that the interest rate will have a large increase to equate $M_d = M_s$. Therefore, the curve will be steep due to $i \uparrow$ a lot and $Y \uparrow$ a little.

$$\begin{aligned} Y \uparrow &\rightarrow M_d \uparrow_{\text{a lot}} \\ i \uparrow_{\text{a lot}} &\rightarrow M_d \downarrow_{\text{a lot}} \end{aligned} \quad \left. \vphantom{\begin{aligned} Y \uparrow &\rightarrow M_d \uparrow_{\text{a lot}} \\ i \uparrow_{\text{a lot}} &\rightarrow M_d \downarrow_{\text{a lot}} \end{aligned}} \right\} M_d = M_s$$

- ② When L_i is small, a decrease a lot means that M_d decrease a little. Then, Y needs to increase a little to control equilibrium. Therefore, the curve will be steep due to $i \uparrow$ a lot and $Y \uparrow$ a little.

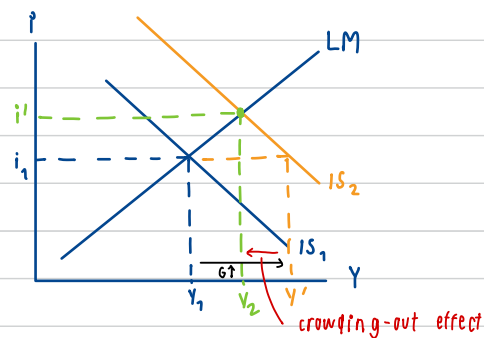
$$\begin{aligned} i \uparrow_{\text{a lot}} &\rightarrow M_d \downarrow \\ Y \uparrow &\rightarrow M_d \uparrow \end{aligned} \quad \left. \vphantom{\begin{aligned} i \uparrow_{\text{a lot}} &\rightarrow M_d \downarrow \\ Y \uparrow &\rightarrow M_d \uparrow \end{aligned}} \right\} M_d = M_s$$

$\therefore$ LM is steep when L_Y is large or L_i is small.

6. What is the Crowding-Out Effect?

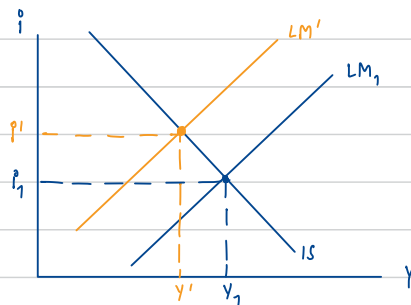
Suppose that the government increases its spending, i.e. expansionary fiscal policy. Use the IS-LM diagram to explain how the economy moves to the new general equilibrium and the crowding-out effect.

Crowding-out effect is when an increase in public spending causes a reduction in private spending. $G \uparrow \rightarrow i \uparrow \rightarrow I \downarrow$



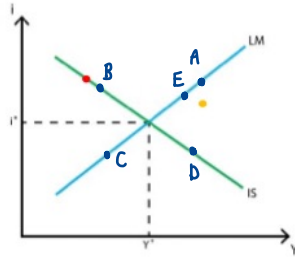
- ① GM: $G \uparrow \rightarrow AE \uparrow \rightarrow Y \uparrow$
- ② MM: $Y \uparrow \rightarrow M_d \uparrow \rightarrow i \uparrow$
- ③ GM: $i \uparrow \rightarrow I \downarrow \rightarrow AE \downarrow \rightarrow Y \downarrow$

7. Suppose the central bank decreases its money supply, i.e. contractionary monetary policy. Use the IS-LM diagram to explain how the economy moves to the new general equilibrium.



- ① MM: $M \downarrow \rightarrow i \uparrow$
- ② GM: $i \uparrow \rightarrow I \downarrow \rightarrow AE \downarrow \rightarrow Y \downarrow$

8. Use the graph below to answer the following questions.



- 8.1 At the **Red** point, which market is in equilibrium, and which is not?
 8.2 Explain how the goods and money markets at the **Orange** point will adjust towards the general equilibrium (Y^*, i^*).

8.1) At the red point, G&S market is in equilibrium and money market is not in equilibrium.

8.2) At the orange point, i is too low.

Using the phase diagram:

Orange point $\rightarrow A$: MM : $i \uparrow$

$A \rightarrow B$: GM : $i \uparrow \rightarrow I \downarrow \rightarrow AE \downarrow \rightarrow Y \downarrow$

$B \rightarrow C$: MM : $Y \downarrow \rightarrow M_d \downarrow \rightarrow i \downarrow$

$C \rightarrow D$: GM : $i \downarrow \rightarrow I \uparrow \rightarrow AE \uparrow \rightarrow Y \uparrow$

And the process will continue on until it is in the equilibrium point.

9. The government is worried about the effectiveness of its policies. You are to advise which policy – fiscal or monetary – should be used in each of the following cases.

9.1 Consumers have high MPC. **Fiscal**

9.2 Investment is NOT sensitive to changes in interest rate. **Fiscal**

9.3 Money demand is very sensitive to changes in interest rate. **Fiscal**

9.4 Money demand is very sensitive to changes in income (Y). **Monetary**

10. Assume a closed economy with the government. The economy has the following parameters:

$$C = 100 + 0.5(Y_d) \quad I = 80 - 100(i) \quad G = 40 \quad T = 40$$

$$L(i, Y) = 0.5(Y) - 200(i) \quad M = 400 \quad P = 2$$

Answer the following questions.

10.1 Derive the IS equation.

10.2 Derive the LM equation.

10.3 Find the general equilibrium output and interest rate.

10.1) $Y = AE$

$$Y = C + I + G$$

$$Y = 100 + 0.5(Y - 40) + 80 - 100(i) + 40$$

$$Y = 100 + 0.5Y - 20 + 80 - 100(i) + 40$$

$$0.5Y = 200 - 100(i)$$

$$Y = 400 - 200(i)$$

10.2) $M_s = M_d$

$$\frac{M}{P} = L(i, Y)$$

$$\frac{400}{2} = 0.5(Y) - 200(i)$$

$$200 = 0.5(Y) - 200(i)$$

10.3) Interest rate

$$400 + 400i = 400 - 200i$$

$$600i = 0$$

$$i = 0$$

The general equilibrium output

$$Y = 400 - 200(0)$$

$$Y = 400$$