

Exercise 6

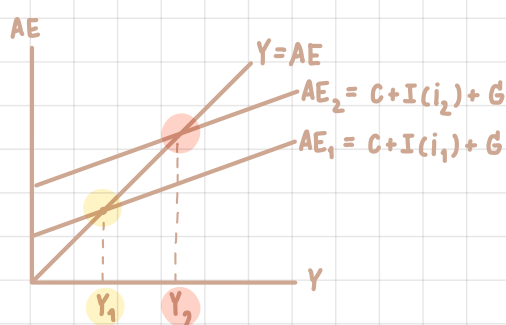
IS-LM Model

- The IS-LM Model is a general equilibrium model, which means that there exists a common price that clears two or more markets.
 There are 2 markets, which are 1. Goods & Services market 2. Money market.
 The price that clears these markets is interest rate.
 The IS curve represents a negative relationship between interest rate (i) and output (Y). This is because higher interest rates discourage investors from investing.
 The LM curve represents a positive relationship between interest rate (i) and output (Y). This is because higher level of Y (people have more income) people have more demand for money to buy goods & services, which drives up interest rate.
 Each point on the IS curve is an equilibrium in the goods & services 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: $M_d = M_s$.
- Ceteris Paribus (other things equal), how will each variable affect each curve – shift (to which direction?) or movement?

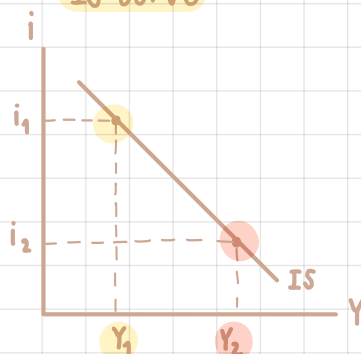
Variable	IS Curve	LM Curve
$i \uparrow$	movement to the left	movement to the right
$G \downarrow$	shift to the left	not affect
$T \downarrow$	shift to the right	not affect
$G \& T \uparrow$ equally	shift to the right	not affect
$M \downarrow$	not affect	shift to the left
$P \downarrow$	not affect	shift to the right

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.

Keynesian Cross



IS curve



each point in IS curve is an equilibrium in Keynesian cross at each level of interest rate

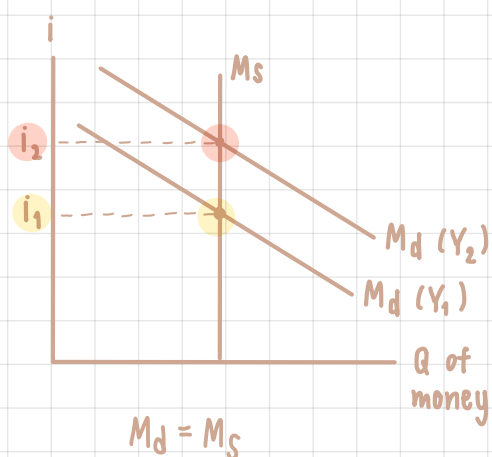
Suppose i decrease from i_1 to i_2
 Lower interest rate encourages investors to invest more.
 Then AE raises, and Y also raises

IS relation

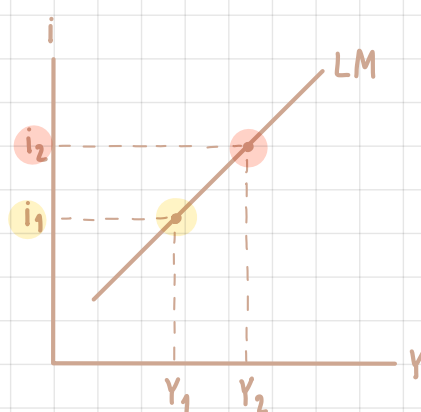
$i \downarrow \rightarrow I \uparrow \rightarrow AE \uparrow \rightarrow Y \uparrow$

negative relationship between i & Y

Money market equilibrium



LM curve



each point in LM curve is an equilibrium in money market at each level of interest rate

Suppose i increase from i_1 to i_2
 M_d will drop, so we have to increase income to shift M_d to the right

When i change, Y has to change too in order for the equality to hold
 whenever i goes up, Y has to go up as well
 because when $i \uparrow \rightarrow M_d \downarrow$ and when $Y \uparrow \rightarrow M_d \uparrow$

The two change in M_d cancel out each other, so M_d remains the same and equal to M_s

LM relation

$Y \uparrow \rightarrow M_d \uparrow$
 $i \uparrow \rightarrow M_d \downarrow$

positive relationship between i & Y

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 ?

I_1 = sensitivity of I to Δ in i (slope of investment function)
 L_Y = sensitivity of M_d to Δ in Y
 L_i = sensitivity of M_d to Δ in i

4.2 Why are I_1 and L_i negative?

Higher interest rates (i) discourage investors from investing due to high cost of borrowing so I_1 and L_i are 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.)

closed economy

$$Y = AE$$

$$Y = C + I + G$$

$$I = I_0 - I_1(i) \quad \left. \begin{array}{l} Y = C_0 + C_1(Y - T_0) + (I_0 - I_1(i)) + G_0 \\ I_1 i = C_0 + C_1 Y - Y - C_1 T_0 + I_0 + G_0 \\ I_1 i = (C_0 + I_0 + G_0 - C_1 T_0) - (1 - C_1) Y \\ i = \frac{(C_0 + I_0 + G_0 - C_1 T_0) - (1 - C_1) Y}{I_1} \end{array} \right\}$$

$$I_1 i = C_0 + C_1 Y - Y - C_1 T_0 + I_0 + G_0$$

$$I_1 i = (C_0 + I_0 + G_0 - C_1 T_0) - (1 - C_1) Y$$

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

4.4 Find the slope of the IS curve.

(Hint: The coefficient before Y is the slope of IS.)

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

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

→ slope of IS
(downward)

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.)

$$\begin{array}{l|l} M_d = M_s & \\ M_s = \frac{M}{P} & \\ \frac{M}{P} = L(Y, i) = L_Y \cdot Y - L_i \cdot i & \frac{M}{P} = L_Y \cdot Y - L_i \cdot i \\ & L_i \cdot i = L_Y \cdot Y - \frac{M}{P} \\ & i = \frac{L_Y \cdot Y}{L_i} - \frac{M}{P \cdot L_i} \end{array}$$

4.6 Find the slope of the LM curve.

(Hint: The coefficient before Y is the slope of LM.)

$$i = \frac{L_Y \cdot Y}{L_i} - \frac{M}{P \cdot L_i}$$

slope of LM

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.

→ Slope of IS depends on

1. Sensitivity of investment to changes in interest rate

high sensitivity → change in interest rate lead to large change in investment & output
flat IS

low sensitivity → change in interest rate lead to small change in investment & output
steep IS

2. investment multiplier

large multiplier → change in investment lead to large change in output
flat IS

small multiplier → change in investment lead to small change in output
steep IS

→ Slope of LM depends on

1. Sensitivity of M_d to change in Y

if L_Y is large LM is steep

if L_Y is small LM is flat

2. Sensitivity of M_d to change in i

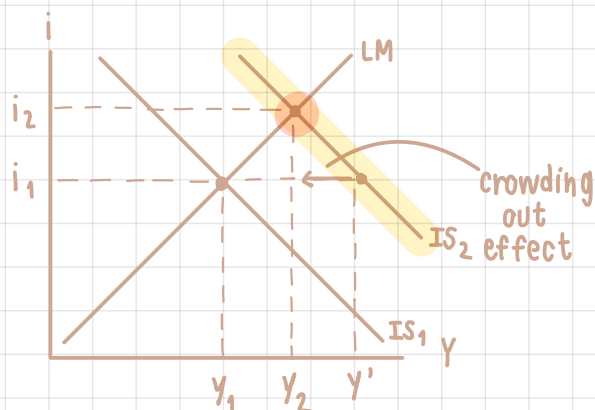
if L_i is large LM is flat

if L_i is small LM is steep

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 : public sector spending (G) reduces or eliminates private sector spending (I)



GM : $G \uparrow \rightarrow AE \uparrow \rightarrow Y \uparrow$

MM : $Y \uparrow \rightarrow M_d \uparrow \rightarrow i \uparrow$

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

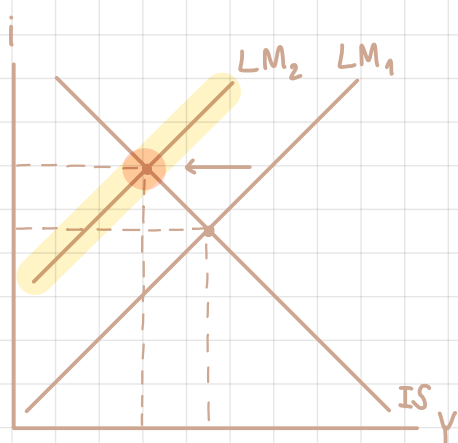
When government increases its spending (G), demand in economy (AE) raise.

Firm produce more to supply at the higher demand, so output (Y) and income in economy raise.

When people have more income, they want to buy more goods, then money demand (M_d) raise (graph shift to the right) making interest rate (i) raised. It discourages investment (I), so output (Y) falls.

As a result, new equilibrium has higher output and higher interest rate.

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.



When central bank decrease money supply (M_s) bond issuer will raise interest rate (i)

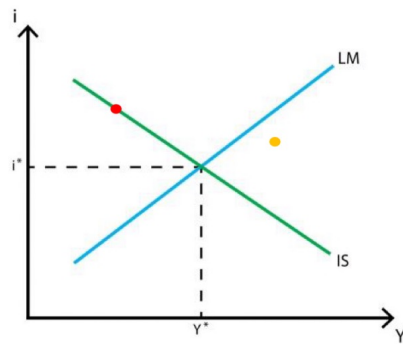
It discourages investment (I), so output (Y) falls. (graph shift to the left)

As a result, new equilibrium has lower output but higher interest rate.

MM : $M_s \downarrow \rightarrow i \uparrow$

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?

At the red point, there is equilibrium in goods & services market, but not in equilibrium at money market.

8.2 Explain how the goods and money markets at the **Orange** point will adjust towards the general equilibrium (Y^* , i^*).

For the goods market, orange point is above the IS curve means $Y > AE$. So the firm should cut back on production to reduce inventory. Then orange point shift to the left and adjust to the equilibrium.

For the money market, orange point is below the LM curve means there is excess M_d , so interest rate (i) should be increase to make it adjust to the equilibrium.

* 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.

shift LM $\rightarrow$ monetary

9.2 Investment is NOT sensitive to changes in interest rate.

$i \uparrow \rightarrow I \downarrow \rightarrow AE \downarrow \rightarrow Y \downarrow$ $\searrow$ IS steep shift IS $\rightarrow$ fiscal
a little a little a little

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

shift IS $\rightarrow$ fiscal

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

shift LM $\rightarrow$ 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.

$$Y = AE$$

$$Y = C + I + G$$

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

$$Y = 220 + 0.5(Y - T) - 100i$$

$$Y = 200 + 0.5(Y - 40) - 100i$$

$$Y = 200 + 0.5Y - 20 - 100i$$

$$0.5Y = 200 - 100i$$

$$100i = 200 - 0.5Y$$

$$i = 2 - 0.005Y$$

10.2 Derive the LM equation.

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

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

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

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

$$i = 0.0025Y - 1$$

10.3 Find the general equilibrium output and interest rate.

$$\left. \begin{array}{l} i = 2 - 0.005Y \\ i = 0.0025Y - 1 \end{array} \right\} \begin{array}{l} 2 - 0.005Y = 0.0025Y - 1 \\ 3 = 0.0075Y \\ Y = 400 \end{array}$$

substitute Y in equation

$$i = 2 - 0.005(400)$$

$$i = 0$$

$$i = 0.0025(400) - 1$$

$$i = 1$$

$$\therefore \text{output } (Y) = 400$$

$$\text{interest rate } (i) = 0$$