

Group Homework 2

Semester 2/2022 EE320 Introductory mathematical economics

Due date: Feb 15th 2022 (before midnight /B.E. moodle).

Note: Late homework will not be accepted. Use the format of filename as required; this will cost you two points if you don't follow the instruction.

1. Consider the ice cream market in Bangkok. In April, the ice cream market demand and supply curves are given by the following equations where Q is the quantity of ice cream units, T is the level of temperature in degree Celsius, and P is the price in dollars per unit of ice cream:

$$\text{Demand: } Q = 10000 + 400 \times (T - 30) - 10P$$

$$\text{Supply: } Q = 2000 + 20P$$

Suppose that $T = 40$ Celsius, find the equilibrium price and quantity of ice cream in April using the Inverse matrix method.

2. Consider a modified version of the IS-LM model where government spending is tied to the level of GDP (Y).

$$C = C_0 + C_1 Y_d - C_2 r, \quad 0 < C_1 < 1$$

$$I = I_0 + I_1 Y - I_2 r, \quad 0 < I_1 < 1$$

$$G = G_0 - G_1 Y, \quad 0 < G_1 < 1$$

$$T = T_0$$

$$M^s = M_0$$

$$L^d = L_0 + L_1 Y - L_2 r$$

where C is the private consumption, I is the private investment, G is the government spending, T is tax, M^s is the level of money supply, L^d is the level of real money demand, and r is the level of nominal interest rate. Suppose that price is fixed equal to 1. All the coefficients are non-negative. Additionally, we assume that $I_1 + C_1 - G_1 < 1$.

- Discuss about the nature of government behavior. Does the assumption over the behavior of government make sense in practice?
- What does C_2 represent? What does it imply about the behavior of private consumption? Does the assumption make sense?
- Derive the IS equation. Interpret the meaning of the IS equation. Discuss about the key relation derived from IS equation.
- Calculate the slope of IS curve. When is the IS curve flat? What does the flat IS curve imply about the sensitivity of real GDP to the interest rate?
- Use the IS equation and calculate the tax multiplier. How does the tax multiplier depend on slope of IS curve?

- f. Derive the LM equation. Interpret the meaning of the LM equation. Discuss about the key relation derived from LM equation.
- g. Calculate the slope of LM curve. When is the LM curve flat? What does the flat LM curve imply about the sensitivity of interest rate to the real GDP?
- h. Write both IS and LM equations in terms of the matrix representation.
- i. Solve for the equilibrium GDP and interest rate (Y^*, r^*) using the Cramer's rule. (*Caution: you will get **ZERO** if you don't use the Cramer's rule.*)
- j. Calculate the multiplier of G_0 and the multiplier of M_0 on both Y^* and r^* , respectively. Discuss whether the multiplier is bigger or smaller than the case that government spending is purely exogenous, i.e. $G_1 = 0$.

The government is seeking for some advices on fiscal and monetary policy implementation. The goal of the government is to (i) *increase the real GDP (Y) by \$100*, while (ii) *keeping the current level of interest rate stayed the same*. (That is, the government was thinking that the country is running into an unemployment situation, but the level of interest rate is now optimal.) Following the storyline given here and all your work that you have done before, answer the next two questions.

- k. Can the government successfully achieve both goals by simply relying on *a single type of policy implemented*? That is, to achieve the two goals, would it work to either change the *government expenditure or money supply*, but not both at the same time? If yes, *under which conditions*?

1. If the condition that you assumed in (k) does not hold, what would you recommend to the government so that both goals can be simultaneously achieved? (Hint: think about an appropriate mixture of the two policies.)

=====

$$1) \quad Q = 10000 + 400(T - 30) - 10P$$

$$T = 40; \quad Q = 10000 + 400(10) - 10P$$

$$Q = 14000 - 10P$$

$$Q + 10P = 14000 \quad \text{--- (1)}$$

$$Q = 2000 + 20P$$

$$Q - 20P = 2000$$

$$\begin{pmatrix} 1 & 10 \\ 1 & -20 \end{pmatrix} \begin{pmatrix} Q \\ P \end{pmatrix} = \begin{pmatrix} 14000 \\ 2000 \end{pmatrix}$$

$$A \cdot X = C$$

$$X = A^{-1} \cdot C; \quad A^{-1} = \frac{1}{-20 - 10} \begin{bmatrix} -20 & -10 \\ -1 & 1 \end{bmatrix} = \frac{1}{-30} \begin{bmatrix} -20 & -10 \\ -1 & 1 \end{bmatrix}$$
$$= \begin{pmatrix} \frac{2}{3} & \frac{1}{3} \\ \frac{1}{30} & -\frac{1}{30} \end{pmatrix}$$

$$X = \begin{pmatrix} \frac{2}{3} & \frac{1}{3} \\ \frac{1}{30} & -\frac{1}{30} \end{pmatrix} \begin{pmatrix} 14000 \\ 2000 \end{pmatrix}$$

$$X = \begin{pmatrix} Q \\ P \end{pmatrix} = \begin{pmatrix} 10000 \\ 400 \end{pmatrix}$$

$$\therefore Q = 10000, \quad P = 400$$

2

a) It seems make sense because when Y increase, the government does not need to spend. However, in reality, the government spending depends on the plan.

b) C_2 show sensitivity between r and C_2 when $r \uparrow$, cost of borrowing decrease. People borrow less. So consumption decrease.

c) IS : $Y = C + I + G$

$$Y = [C_0 + C_1(Y-T) - C_2r] + [I_0 + I_1Y - I_2r] + G_0 - G_1Y$$

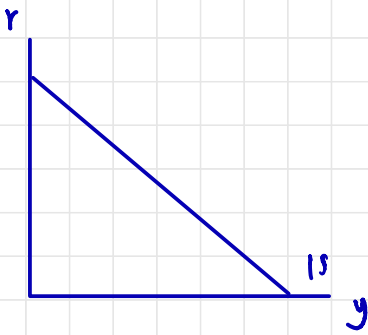
$$Y = C_0 + C_1Y - C_1T - C_2r + I_0 + I_1Y - I_2r + G_0 + G_1Y$$

$$Y - C_1Y - I_1Y - G_1Y = C_0 - C_1T + I_0 + G_0 - [C_2 + I_2]r$$

$$(1 - C_1 - I_1 - G_1)Y = C_0 - C_1T + I_0 + G_0 - [C_2 + I_2]r$$

So

$$Y = \frac{C_0 - C_1T + I_0 + G_0}{1 - C_1 - I_1 - G_1} - \frac{C_2 + I_2}{1 - C_1 - I_1 - G_1} \cdot r$$



$$d) \text{ Slope IS} = \frac{dr}{dy} = 1/[dy/dr]$$

$$\frac{dy}{dr} = \frac{-[C_2 + I_2]}{[1 - C_1 - I_1 - G_1]}$$

$$S_0 \frac{dr}{dy} = - \left[\frac{1 - C_1 - I_1 - G_1}{C_2 + I_2} \right]$$

IS will flate when $[C_2 + I_2] \uparrow$, $[1 - C_1 - I_1 - G_1] \downarrow$

yes when IS flat

$m \uparrow \rightarrow r \downarrow \rightarrow I \uparrow \uparrow \rightarrow Y \uparrow \uparrow \uparrow$

$$E) \quad Y = \frac{C_0 - C_1 T + I_0 + G_0}{1 - C_1 - I_1 - G_1} - \frac{C_2 + I_2}{1 - C_1 - I_1 - G_1} \cdot r$$

$$\frac{dy}{dT} = \text{tax multiplier} = \frac{-C_1}{1 - C_1 - I_1 - G_1}$$

f) LM curve

$$\frac{M^s}{P} = L^d \quad \} \text{ LM equation}$$

$$\frac{M_0}{P} = L_0 + L_1 y - L_2 r$$

$$L_1 y = \frac{M_0}{P} - L_0 + L_2 r$$

$$y = \frac{M_0}{L_1 P} - \frac{L_0}{L_1} + \frac{L_2}{L_1} r$$

$$G) \text{ Slope } LM = \frac{dr}{dy}$$

$$\frac{dy}{dr} = \frac{L_2}{L_1}$$

$$\therefore \text{ Slope } LM = \frac{dr}{dy} = \frac{1}{\left[\frac{L_2}{L_1} \right]} = \frac{L_1}{L_2}$$

LM will flat if L_1 decrease or L_2 increase

$$H) \text{ IS } y = \frac{C_0 - C_1T + I_0 + G_0}{1 - C_1 - I_1 - G_1} - \frac{C_2 + I_2}{1 - C_1 - I_1 - G_1} \cdot r$$

$$y + \frac{C_2 + I_2}{1 - C_1 - I_1 - G_1} \cdot r = \frac{C_0 - C_1T + I_0 + G_0}{1 - C_1 - I_1 - G_1} \quad (1)$$

$$\text{LM } y = \frac{M_0}{L_1P} - \frac{L_0}{L_1} + \frac{L_2}{L_1} r$$

$$y - \frac{L_2}{L_1} r = \frac{M_0}{L_1P} - \frac{L_0}{L_1} \quad (2)$$

$$\therefore \begin{bmatrix} 1 & \frac{C_2 + I_2}{1 - C_1 - I_1 - G_1} \\ 1 & -\frac{L_2}{L_1} \end{bmatrix} = \begin{bmatrix} y \\ r \end{bmatrix} = \begin{bmatrix} \frac{C_0 - C_1T + I_0 + G_0}{1 - C_1 - I_1 - G_1} \\ \frac{M_0}{L_1P} - \frac{L_0}{L_1} \end{bmatrix}$$

$$I) \begin{bmatrix} 1 & \frac{C_2 + I_2}{1 - C_1 - I_1 - G_1} \\ 1 & -\frac{L_2}{L_1} \end{bmatrix} = \begin{bmatrix} y \\ r \end{bmatrix} = \begin{bmatrix} \frac{C_0 - C_1T + I_0 + G_0}{1 - C_1 - I_1 - G_1} \\ \frac{M_0}{L_1P} - \frac{L_0}{L_1} \end{bmatrix}$$

$$\begin{bmatrix} 1 & A \\ 1 & B \end{bmatrix} \begin{bmatrix} y \\ r \end{bmatrix} = \begin{bmatrix} C \\ D \end{bmatrix}$$

$$y = \frac{\begin{vmatrix} C & A \\ D & B \end{vmatrix}}{\begin{vmatrix} 1 & A \\ 1 & B \end{vmatrix}} = \frac{CB - DA}{B - A}$$

$$r = \frac{\begin{vmatrix} 1 & C \\ 1 & D \end{vmatrix}}{\begin{vmatrix} 1 & A \\ 1 & B \end{vmatrix}} = \frac{D - C}{B - A}$$

$$y = \frac{\left[\frac{C_0 - C_1 T + I_0 + G_0}{1 - C_1 - I_1 - G_1} \right] \left[-\frac{L_2}{L_1} \right] - \left[\frac{M_G - L_C}{L_1 P} - \frac{L_C}{L_1} \right] \left[\frac{C_2 + I_2}{1 - C_1 - I_1 - G_1} \right]}{\left[-\frac{L_2}{L_1} \right] - \left[\frac{C_2 + I_2}{1 - C_1 - I_1 - G_1} \right]}$$

$$r = \frac{\left[\frac{M_G - L_C}{L_1 P} - \frac{L_C}{L_1} \right] - \left[\frac{C_0 - C_1 T + I_0 + G_0}{1 - C_1 - I_1 - G_1} \right]}{\left[-\frac{L_2}{L_1} \right] - \left[\frac{C_2 + I_2}{1 - C_1 - I_1 - G_1} \right]}$$

Group Homework 2

untitled Notebook...


x Sheet 1

x Image

x MK 326 Chapter 4...

x MK 326 Chapter 1...

x MK 311-2-2021-H...

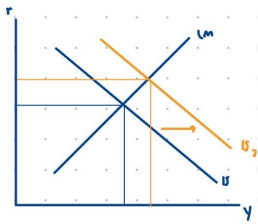
x Group Homew... 

$$J) \text{ Find } G_0 = G + G_1 Y \quad M_0 = PL_0 + PL_1 - PL_2 r$$

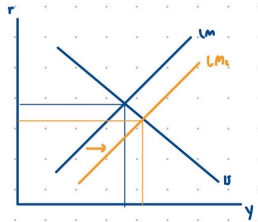
$$\begin{aligned} \frac{dy}{dm_0} &= (P + L_0) + (P + L_1) - (L_2 r + P_r + PL_2) \\ &= P + L_0 + P + L_1 - L_2 r - P_r - PL_2 \end{aligned}$$

$$\frac{dy}{dG_0} = 1 + G_1 + Y$$

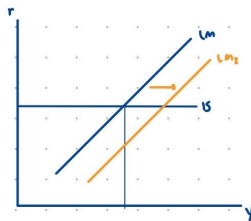
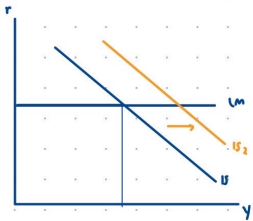
k) No, because if we use only fiscal policy it makes IS (change IS curve) $\rightarrow Y \uparrow$ but $r \downarrow$



if we use only monetary policy, it makes LM (change LM curve) $\rightarrow Y \uparrow$ but $r \downarrow$



And it would work if either IS or LM were flat.



I) the government have to rise the government spending and CB have to increase the Money supply.

