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Problem Set II: Solution

EE212 — Principles of Macroeconomics

Semester 2/2019-2020

Total mark: 20 points

Due date: Saturday 29 February 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 5% of your total grade (20% 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 (5 points)

1. "The Keynesian multiplier is always great than 1 if $T = 0$ and $G = 0$." True or false? Why?

   Answer: This is true *if and only if* $c_1 < 0$. In a model without government spendings and taxes, at the market equilibrium:

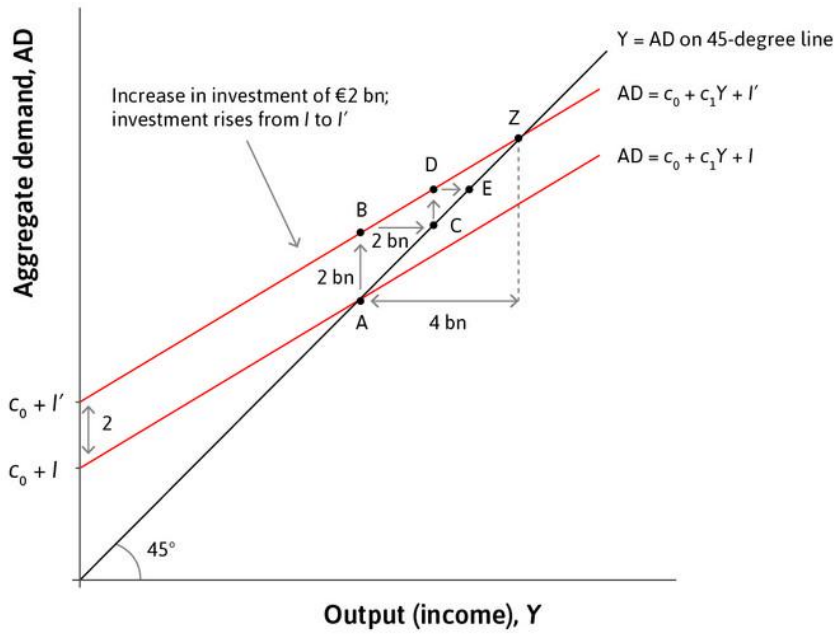
$$\begin{aligned} Y^* &= C + I \\ &= c_0 + c_1 Y^* + I \\ \Rightarrow Y^* &= \frac{1}{1 - c_1}\Big(c_0 + I\Big) \end{aligned}$$

   The multiplier is $1/(1-c_1)$, which is higher than 1 if $c_1 \in (0, 1)$. This means that if the marginal propensity to consume is less than 1 – meaning people do not consume 100% of their income – the multiplier will always be larger than 1. The size of T and G is irrelevant.

2. "There is no private savings at the Keynesian equilibrium." True or false? Why?

   Answer: If firm's investment exists, there is always positive private savings. One way to think of this is that, *at the equilibrium* with only households (which would be a very unrealistic model), private savings would be zero since $C = Y$. With the presence of I but no G and T, then S will be positive since $Y = C + I$. This logically implies that $S = I$.

3. Let's say there is no government spending and taxes, and no imports and exports. The consumption function is given by $C = c_0 + c_1 Y$, and I (investment) is given. The economy is graphically visualised as below:



   There is a \$2 billion increase in investment. The marginal propensity to consume is 0.5. Which of the following statement is correct? (multiple correct answers may be possible)

   (A) The new goods market equilibrium after the investment increase is E.

   (B) Aggregate demand increases by a total of \$2 billion $\times$ 0.5 = \$1 billion due to the increase in investment.

   (C) The multiplier is 2.

   (D) The distance between C and D is three-quarters the distance between A and B (\$1.5 billion).

Answer: The only correct answer is (C). (A) is clearly incorrect since at point E, the aggregate demand is higher than actual output. (B) is also incorrect since the aggregate demand would actually increase by \$4 billion. This is due to the fact that, in this simple model, the multiplier is 2 – (C) is correct. Lastly, (D) is incorrect. Between point A and B, is the initial increase in investment, which leads directly to a direct \$2 billion increase in Y (point C). From point C to point D is the rise in the aggregate demand due to additional consumption by the household from the \$2 billion increase in Y, which equal \$2 billion $\times$ 0.5 = \$1 billion. This process repeats until we reach point Z at which the aggregate output equals aggregate demand once again.

4. The Keynesian multiplier says that an increase in investment or government spending can lead to an even higher increase in total output. Explain how with intuition how it works, and how does it relate to the MPC.

   Answer: This is actually very similar to problem 1.3. The multiplier effect is characterised by the sum of all successive increases/decreases in production after an initial rise/fall in the demand. This could happen, for example, because of the fact that an increase in demand leads to an increase in production. This translates into higher income for the household (through higher employment to supply the extra demand). Since the household consumes part of their additional income (represented by the MPC), this leads to successive increases in production as mentioned before.

   Extra: To show this mathematically, let's say the initial increase in AD equals to k. The subsequent second-round increase in demand is $c_1 \times k$. The third-round increase is $c_1^2 \times k$, and on and on.

   After $n+1$ rounds, we have the sum of all increases as

$$k + c_1 k + c_1^2 k + \cdots + c_1^n k = k(1 + c_1 + c_1^2 + \cdots + c_1^n)$$

   This is clearly a geometric series. And we can show that the multiplier – let's call it m here – is thus

$$m = 1 + c_1 + c_1^2 + \cdots + c_1^n$$

   Multiplying both sides by $(1 - c_1)$, we have

$$\begin{aligned} m(1-c_1) &= (1 + c_1 + c_1^2 + \cdots + c_1^n)(1 - c_1) \\ &= (1 + c_1 + c_1^2 + \cdots + c_1^n) - (c_1 + c_2 + c_1^3 + \cdots + c_1^{n+1}) \\ &= 1 - c_1^{n+1} \\ \text{dividing both sides... } m &= \frac{1 - c_1^{n+1}}{1 - c_1} \end{aligned}$$

   As n gets large (the increase happens infinite number of times), the numerator tends to 1. So...

$$\lim_{n \to \infty} m = \frac{1}{1 - c_1}$$

5. The fiscal (government spending) multiplier tends to be high during a recession, but they tend to be low (perhaps even lower than one) during an expansion. How could we explain this phenomenon?

   Answer: This could happen when the economy is already working at full capacity utilisation (all resources are being used in production) – e.g. during a boom. As a result, if the government increases spendings, the resources are actually drawn from the firms in order for the increase in G to happen. This means that public spending is *crowding out* private investment.

   Another way, *which we have not discussed yet*, is that fiscal expansion (including deterioration in the budget balance) could lead to a rise in the interest rate, discouraging investments.

Problem II: The Keynesian Cross in a small closed and open economy (10 points)

Assume that, in a closed economy:

$$\begin{aligned} C &= 500 + 0.5Y_D \\ I &= 100 \\ T &= 80 \\ G &= 200 \end{aligned}$$

1. (0.5 point) Solve for (i) equilibrium consumption; (ii) "planned" aggregate expenditure (aggregate demand); (iii) disposible income. Characterise the equilibrium.

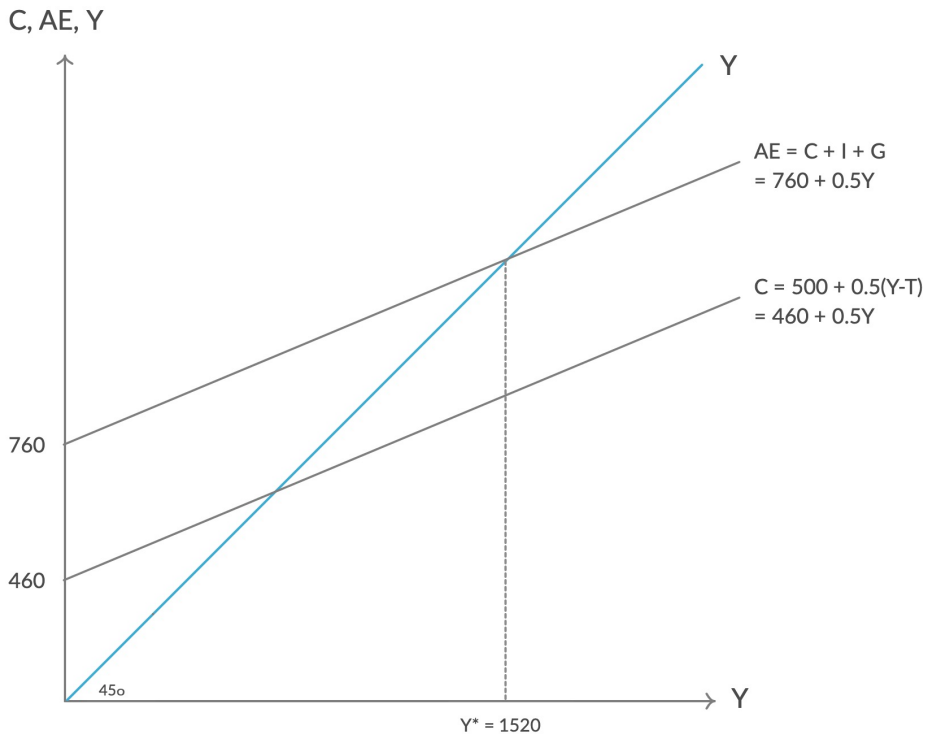
   Answer: The aggregate demand can be characterised as

$$\begin{aligned} AE &= C + I + G \\ &= 500 + 0.5(Y - T) + 100 + 200 \\ &= 500 + 0.5(Y - 80) + 100 + 200 \\ &= 760 + 0.5Y \end{aligned}$$

   The equilibrium is when output matches the aggregate demand

$$\begin{aligned} Y^* &= 760 + 0.5Y^* \\ Y^* &= \frac{760}{0.5} = 1520 \\ \therefore Y_d &= Y - T = 1520 - 70 = 1440 \\ C &= 500 + 0.5(1440) = 1220 \end{aligned}$$

2. (0.5 point) Graph – with proper labels – the equilibrium output and expenditure



3. (1 point) Solve for the equilibrium private savings and public savings.

   Answer: Private savings, $S_{private}$:

$$\begin{aligned} S_{private} &= Y - C - T = 1520 - 1220 - 80 \\ \therefore S_{private} &= 220 \end{aligned}$$

   Public savings, S_{public}:

$$\begin{aligned} S_{public} &= T - G = 80 - 200 \\ \therefore S_{public} &= -120 \end{aligned}$$

4. (1 point) Calculate the Keynesian multiplier, as well as the autonomous spending. What do they mean?

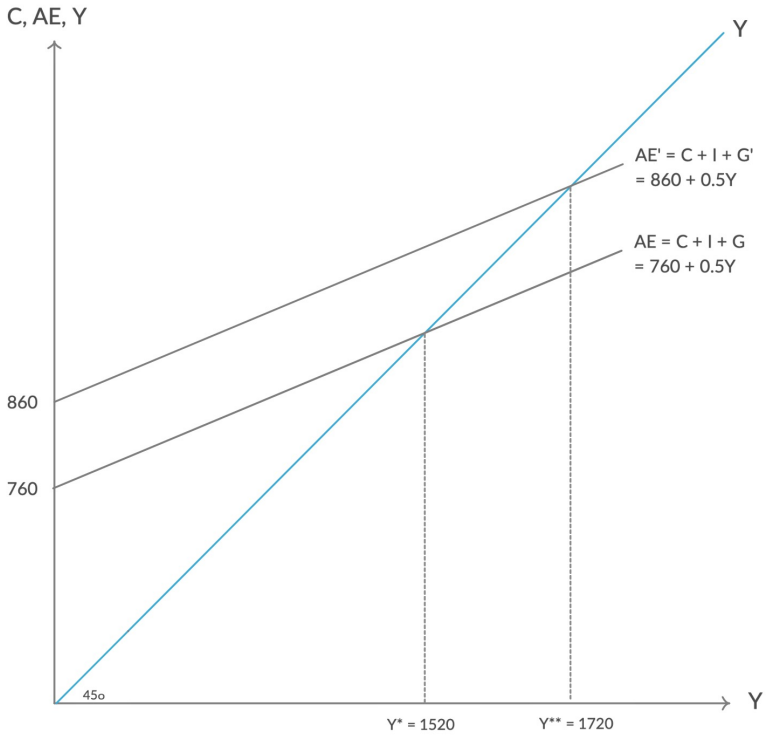
   Answer: The multiplier, in this model, is $1/0.5 = 2$. The autonomous spending, , is $c_0 - c_1 T + I + G = 500 - 0.5(80) + 100 + 200 = 760$.

5. (1 point) It is election year, and the incumbent government increases their government spending from 200 to 300. Find the new equilibrium demand, output, consumption, and disposable income. How much does each increase? Graph these changes. Why would the government want to do this?

   Answer: The new equilibrium output and demand is $Y^{**} = 860/0.5 = 1720$. That is, there is an increase of 200 due to the multiplier being 2. We then have,

$$\begin{aligned} Y^{**} &= 1720 \\ C &= 460 + 0.5(1720) = 1320 \\ Y_d &= Y^{**} - T = 1720 - 80 = 1640 \end{aligned}$$

   Consumption increases by 100 (half of the total increase in total equilibrium output). Disposable income increases exactly by 200 since tax did not change.



Now let's consider a small open economy where the exchange rate and interest rate are pegged on the US.

$$\begin{aligned} C &= c_0 + c_1(Y - T) \\ I &= d_0 + d_1 Y - d_2 r \\ M &= m_1 Y \\ X &= x_1 Y^W \end{aligned}$$

Let r be the exogenous interest rate, and Y^W the level of foreign outputs. G is exogenous.

6. (1 point) All coefficients (e.g. c_1, d_1, d_2) are positive. According to your understanding, what is d_1 and d_2? What are the reasons for the signs before them (plus or minus)?

   Answer: d_1, with the positive sign, explicitly characterise the assumption that firms would marginally invest more when aggregate output or income is higher. Meanwhile, d_2 denotes the negative relationship between r and I. This is due to the fact that r, the interest rate, represents both the cost of borrowing (in order to finance investments) as well as the opportunity cost of holding financial assets (instead of investing).

7. (3 points) What is the effect of lower government spending ($G \downarrow$) on the budget balance, $G - T = G - tY$? Assuming that $\big(1 - c_1(1-t) - d_1 + m_1\big) < 1$, and the linear tax rate t is constant.

   First, let's characterise the equilibrium.

$$\begin{aligned} AE &= C + I + G + (X - M) \\ &= c_0 + c_1(Y - tY) + d_0 + d_1 Y - d_2 r + G + x_1 Y^W - m_1 Y \\ &= c_0 + c_1(1-t)Y + d_0 + d_1 Y - d_2 r + G + x_1 Y^W - m_1 Y \\ &= \Big(c_0 + d_0 - d_2 r + G + x_1 Y^W\Big) + \Big(c_1(1-t) + d_1 - m_1\Big)Y \end{aligned}$$

   The intercept of the AE is the first bracket (it does not relate to Y), and the slope is the second bracket. At the equilibrium, we have

$$Y^* = \frac{1}{1 - c_1(1-t) - d_1 + m_1}\Big(c_0 + d_0 - d_2 r + G + x_1 Y^W\Big)$$

   The fiscal multiplier is the fraction, and the autonomous spending is all the terms in the bracket.

$$\frac{\partial Y^*}{\partial G} = \frac{1}{1 - c_1(1-t) - d_1 + m_1}$$

   As such, a *one-unit decrease* in government spending would lead to an even larger decrease in the *equilibrium* output given by:

$$\frac{-1}{1 - c_1(1-t) - d_1 + m_1}$$

   The budget balance is actually $T - G = tY - G$. However, the intuition does not change. The change in the budget balance due to changes in G would then be:

$$\begin{aligned} t\frac{\partial Y^*}{\partial G}dG - dG &= t\Big(\frac{1}{1 - c_1(1-t) - d_1 + m_1}\Big)(-1) - (-1) \\ &= \frac{-t}{1 - c_1(1-t) - d_1 + m_1} + 1 \end{aligned}$$

   Thus, the one-unit reduction in government spending would indeed lead to an improvement in the budget balance by the same amount. However, due to the multiplier effect, this would **also** lead to a larger

decrease in equilibrium output. And since the revenue is raised based on a linear tax on total income (which equals output), the government's revenue falls simultaneously.

The budget balance would thus improve if

$$\begin{aligned} & tdY & < & \ dG \\ \Leftrightarrow & \frac{t}{1-c_1(1-t)-d_1+m_1} & < & \ 1 \end{aligned}$$

That is, the reduction in the revenue raised through taxation *is lower than* the reduction in spendings. Lastly, the budget balance would deteriorate if the opposite is true.

8. (2 points) Suppose that the government is budget balanced – given by $G = T = tY$. Find the equilibrium output in this economy. How does the equilibrium output change when foreign output increases?
Tip: replace G and T by tY.

In this case, the equilibrium could be characterised by

$$\begin{aligned} AE &= C + I + G + (X - M) \\ &= c_0 + c_1(Y - tY) + d_0 + d_1 Y - d_2 r + tY + x_1 Y^W - m_1 Y \\ &= c_0 + c_1(1-t)Y + d_0 + d_1 Y - d_2 r + tY + x_1 Y^W - m_1 Y \\ &= \Big(c_0 + d_0 - d_2 r + x_1 Y^W\Big) + \Big(c_1(1-t) + d_1 + t - m_1\Big)Y \\ \Rightarrow Y^* &= \frac{1}{1 - c_1(1-t) - d_1 - t + m_1}\Big(c_0 + d_0 - d_2 r + x_1 Y^W\Big) \end{aligned}$$

The impact of changes in the foreign output on domestic output is:

$$\frac{\partial Y^*}{\partial Y^W} = \frac{x_1}{1 - c_1(1-t) - d_1 - t + m_1}$$

Generally, we should expect this effect to be positive.