Midterm Examination

IFMR GSB, Krea University (Batch: 2019-21)
Macroeconomics (Course Code: **ECON502**)
24 October 2019

Maximum Points: 60 **Duration**: 150 minutes

Instructions and Advice:

- This exam accounts for **30 percent** of your final grade.
- The question paper is divided in two sections- Part A and Part B.
- You need to answer 7 questions in all. [2 from Part A, and 5 from Part B]
- You can choose between Question 1 and Question 2, and between Question 3 and Question 4.
- All other questions are compulsory.
- Please be brief and precise in your answers. Unnecessarily lengthy answers will attract penalty.
- Please label your graphs correctly.
- At no point of this examination you are allowed to ask clarificatory questions. Make reasonable assumption if you have doubts and proceed to answer the question.
- You are **not allowed** to use calculator in the exam.
- There is plenty of time. Use it wisely, do not rush.
- All the best!

Part A

1. (4 points) Suppose that money demand is given by

$$M_d = Y \cdot (0.25 - i)$$

(a) (2 points) If $Y = 80$, what is the smallest value of the money supply at which the interest rate is zero?

> **Solution:** To set $i = 0$, we can use the equation and the equilibrium condition ($M_d = M_s$) to find out the minimum money supply (M_s^{min}).
>
> $$\begin{aligned} M_d &= M_s \\ M_s^{min} &= 80 \cdot (0.25 - 0) \\ M_s^{min} &= \frac{80}{4} = 20 \end{aligned}$$

(b) (2 points) Once the interest rate is zero, can the central bank continue to increase the money supply?

> **Solution:** Once the interest rate is zero, theoretically money supply cannot increase (because it would mean that the nominal interest rate becomes negative).[1]

Or

2. (4 points) *Suppose that you are measuring the annual GDP of India for 2019*.
Determine the effect on GDP of each of the following transactions that happened during 2019.

a A seafood restaurant in Chennai buying ₹1,000 worth of fish from a fisherman.

> **Solution:** The fish that was bought by the restaurant is an **intermediate good**. GDP does not change.

b A family spends ₹1000 on dinner at that seafood restaurant.

> **Solution:** The dishes served in the restaurant are the final product. Therefore, the GDP increases by ₹1000.

c Air India buying a new Boeing aircraft for ₹100 million.

[1] However, there are instances where the central banks around the world have expanded money supply even when the interest rate is zero. Read: `https://www.economist.com/the-economist-explains/2015/03/09/what-is-quantitative-easing`.

Solution: The purchase of an aircraft can be viewed as an investment. GDP goes up by ₹100 million. [2]

d Air India sells that aircraft to Indigo for ₹60 million.

Solution: Resale of goods are not considered to be part of GDP. GDP remains unchanged.

3. (6 points) Suppose that the production function takes the form

$$Y = K^{\alpha} \cdot (AN)^{(1-\alpha)}$$

where $\alpha = \frac{2}{3}$.
Assume that the saving rate, $s = 0.15$, and the rate of depreciation, $\delta = 0.05$. Further, let $A = 3$, and $N = 2$. Derive the steady-state levels of output per worker and capital per worker in terms of the saving rate, s, and the depreciation rate, δ.

Solution:

$$Y = K^{\alpha} \cdot (AN)^{(1-\alpha)}$$
$$\frac{Y}{N} = \left(\frac{K}{N}\right)^{\alpha} \cdot (A)^{1-\alpha}$$

Relabel $(A)^{1-\alpha} = T$. Therefore, $\frac{Y}{N} = T \cdot \left(\frac{K}{N}\right)^{\alpha}$.

We also know the steady state condition (which states that the change in capital per labour must vanish).

$$\Delta K = s \cdot Y - \delta K$$
$$\frac{\Delta K}{N} = s \cdot \frac{Y}{N} - \delta \frac{K}{N}$$
$$\frac{\Delta K}{N} = 0$$
$$s \cdot \frac{Y}{N} - \delta \frac{K}{N} = 0$$
$$s \frac{Y^*}{N} = \delta \frac{K^*}{N}$$

[2] There are two more cases which can be considered as equally valid as above.

1 The same can also be thought of as a government expenditure if you consider the fact that Air India is publicly-funded company. In this case, same as the one described in the solution, GDP goes by by ₹100 million.

2 You might think of Boeing as a foreign company in which case the GDP will decline by ₹100 million.

Now, you can substitute the relationship between output per worker as a function of capital per worker.

$$s \cdot T \cdot \left(\frac{K^*}{N}\right)^{\alpha} = \delta \frac{K^*}{N}$$

$$\frac{K^*}{N} = A^{\frac{1-\alpha}{1-\alpha}} \cdot \left(\frac{s}{\delta}\right)^{\frac{1}{1-\alpha}}$$

$$\frac{K^*}{N} = A \cdot \left(\frac{s}{\delta}\right)^{\frac{1}{1-\alpha}}$$

We know that $A = 3$, $s = 0.15$, $\delta = 0.05$, and $\alpha = 2/3$. Put these values and you have:

$$\frac{K^*}{N} = 3 \cdot \left(\frac{0.15}{0.05}\right)^{\frac{1}{1-2/3}}$$

$$\frac{K^*}{N} = 3 \cdot (3)^3$$

$$\frac{K^*}{N} = 81$$

We can now compute output per worker.

$$\frac{Y^*}{N} = T \cdot \left(\frac{K^*}{N}\right)^{\alpha}$$

$$\frac{Y^*}{N} = 3^{1/3} \cdot (81)^{2/3}$$

$$\frac{Y^*}{N} = 27$$

Or

4. (6 points) What happens to the **unemployment rate** and the **labour force participation rate** (increase/decrease/does not change/ambiguous effect) if each of the following scenarios occurs? Explain briefly.

Solution: Let the number of employed and unemployed people be E and U, and the total population in the working age group be P. The unemployment rate, u, is given by

$$u = \frac{U}{L} \tag{1}$$

and, the labour force participation rate, $LFPR$, is

$$LFPR = \frac{U + E}{P} \tag{2}$$

a Ramadhir loses his job since he had a fight with a customer.

Solution: u goes up as we now have $U + 1$ unemployed people in the workforce. $LFPR$ remains the same. Using equation 2, we can write:

$$LFPR = \frac{(U + 1) + (E - 1)}{P}$$
$$LFPR = \frac{U + E}{P}$$

b Faizal finds a job with Barclays after a month-long job-search.

Solution: u goes down (as the number of unemployed people now is $U - 1$), and $LFPR$ remains the same.

$$LFPR = \frac{(U - 1) + (E + 1)}{P}$$
$$LFPR = \frac{U + E}{P}$$

c The working-age population is reclassified to 21-65, from 15-60.

Solution: In this case, all the variables U, E, and P will be affected. So, changes in the unemployment rate and the labour force participation rate will depend upon the distribution of populations in the two age groups.

Part B

5. (10 points) On September 20th, the Indian Finance Minister announced corporate tax-rate cut, and the RBI is anticipated to announce another round of interest rate cut in October this year.

   (a) (6 points) Using the $IS - LM$ model, explain what is going to happen to the Indian economy in the short run.

   Solution: In the short run, as a result of the corporate tax-rate cut, we will see that the IS curve will shift to the right (reason: investment will increase[3]). So, the equilibrium output Y, and the equilibrium interest rate i will go up. Anticipating this rise in interest rate, the RBI decides to increase the money supply moving the LM curve to right. Now, we have lower interest rate than anticipated, and higher output.

   (b) (4 points) Explain why using a policy-mix of this sort may be problematic.

[3] I will deduct points if you do not write this explicitly.

Solution: Let us go back to the textbook. Assume that the budget deficit has been rising. The right strategy is to combine a fiscal contraction (so as to get rid of the deficit with a monetary expansion ensuring that the output and demand remain on course[4]

6. (10 points) *Suppose that before ATMs and credit cards, a person goes to the bank once and withdraws from her account all the money that she needs for four days. Assume that she needs ₹10 per day.*
   Compute the following statistics: **money withdrawn**, and **amount of money that the person holds** given that:

Solution: For any given day,

$$\text{Amount of money held} = \text{money withdrawn or used} - \text{money spent.} \quad (3)$$

It will be useful to define an average money holding because that gives you a measure of money demand.

$$\text{Money demand} = \text{Sum}(\text{Amount of money held each day})/4 \quad (4)$$

(a) (2 points) When there are no ATMs or credit cards.

Solution: Money withdrawn = ₹40;

Day	Money Holding
1	40
2	40 - 10 = 30
3	40 - 20 = 20
4	40 - 30 = 10

Money demand =(40 + 30 + 20 + 10)/4 = ₹25

(b) (2 points) When the bank issues debit card to the person.

Solution: The answer to this part depends upon your assumptions, but we know that the person needs ₹10 every day. You can build numerous colourful scenarios around spending and withdrawals from the ATM machine. So, on day 1, the minimum withdrawal with debit card should be ₹10.
Scenario 1: Person withdraws ₹10 each day. Money withdrawn = ₹40

[4] As per the textbook

This was the strategy adopted and carried out by Bill Clinton (who was in charge of fiscal policy) and Alan Greenspan (who was in charge of monetary policy). The result of this strategy - and a bit of economic luck - was a steady reduction of the budget deficit (which turned into a budget surplus at the end of the 1990s) and a steady increase in output throughout the rest of the decade.

Day	Money Holding
1	10
2	20 - 10 = 10
3	30 - 20 = 10
4	40 - 30 = 10

Money demand = (10 + 10 + 10 + 10)/4 = ₹10.
Scenario 2: The person makes two equal withdrawals of ₹20 with a day's gap. Money withdrawn = ₹40

Day	Money Holding
1	20
2	20 - 10 = 10
3	40 - 20 = 20
4	40 - 30 = 10

Money demand = (20 + 10 + 20 + 10)/4 = ₹15.

(c) (2 points) When the bank also issues a credit card to the person.

Solution: This should be easy to think about. We rule out the possibility that the person does not use the credit card. With that out of our way, let's think about credit card usage. The idea is simple. The person uses the credit card for all her purchases and at the end of the fourth day, pays her bill (let's assume that there's no internet billpay option) in cash. So, the amount withdrawn = ₹40.

Day	Money Holding
1	0
2	10 - 10 = 0
3	10 - 10 = 0
4	10 - 10 + 40 = 40

Money demand =(0 + 0 + 0 + 40)/4 = ₹10

(d) (4 points) Based on your answers to previous parts, what do you think is the impact of credit cards and ATMs on money demand?

Solution: Based on what you have seen above, it is clear that until and unless the person refuses to use debit or credit card for her transactions, her money demand is going to go down.

7. (10 points) *Suppose the economy is characterized by the following behavioural equations:*

$$C = 10 + 0.6 \cdot Y_D$$
$$I = 10 + 0.2 \cdot Y$$
$$G = 10 + 0.1 \cdot Y$$
$$T = 0.5 \cdot Y$$

(a) (4 points) Solve for equilibrium output. What is the value of the multiplier?

Solution:

$$
\begin{aligned}
Y &= C + I + G \\
Y &= \underbrace{[10 + 0.6 \cdot (Y - \underbrace{0.5Y}_{\text{Tax}})]}_{\text{C}} + \underbrace{(10 + 0.2 \cdot Y)}_{\text{I}} + \underbrace{(10 + 0.1 \cdot Y)}_{\text{G}} \\
Y &= 30 + 0.6 \cdot Y \\
Y &= \frac{1}{1 - 0.6} \cdot 30 \\
Y^* &= 75; \text{multiplier} = \frac{1}{1 - c_1} = \frac{1}{1 - 0.6} = 2.5
\end{aligned}
$$

(b) (6 points) Suppose that now government increases the tax rate to 80%. Because of this tax change, there are spillovers to investments, and the business confidence declines. So, the new investment equation becomes:

$$I = 8 + 0.2 \cdot Y$$

Compute the change in equilibrium output, the change in investment, and the change in national savings.

Solution: What's the new tax equation? It is $T = 0.8 \cdot Y$.

$$
\begin{aligned}
Y &= C + I + G \\
Y &= [(10 + 0.6 \cdot (Y - 0.8 \cdot Y)] + (8 + 0.2 \cdot Y) + (10 + 0.1 \cdot Y) \\
Y &= 28 + 0.42 \cdot Y \\
Y^*_{\text{new}} &\approx 48
\end{aligned}
$$

The change in output = $Y^*_{\text{new}} - Y^*$ = 48 - 75 = - **27**.

Initial investment, $I^* = 10 + 0.2 \cdot Y^* = 10 + 0.2 \cdot 75$ = 25.
New investment, $I^*_{\text{new}} = 8 + 0.2 \cdot Y^*_{\text{new}} \approx 8 + 0.2 \cdot 48 \approx$ 18.
The change in investment = $I^*_{\text{new}} - I^* = 25 - 18$ = - **7**.

National savings $= I + (T - G)$
Initial national savings =

$$
\begin{aligned}
I^* + (T^* - G^*) &= 25 + (0.5 \cdot 75 - (10 + 0.1 \cdot 75)) \\
I^* + (T^* - G^*) &= 25 + 20 \\
I^* + (T^* - G^*) &= 45
\end{aligned}
$$

New national savings =

$$
\begin{aligned}
I^*_{\text{new}} + (T^*_{\text{new}} - G^*_{\text{new}}) &= 18 + (0.8 \cdot 48 - (10 + 0.1 \cdot 48)) \\
I^*_{\text{new}} + (T^* - G^*_{\text{new}}) &= 18 + (38.4 - 14.8) \\
I^*_{\text{new}} + (T^* - G^*_{\text{new}}) &\approx 42
\end{aligned}
$$

The change in national savings = 42 - 45 $\approx$ -**3**

8. (10 points) *Suppose the economy begins with output equal to its natural level. Then, the OPEC makes an announcement such that the oil prices rise.*

   (a) (6 points) Using the $AS - AD$ model, show what happens to output and the price level in the short run and the medium run?

   Solution: This is straight from the textbook. Please look at Section 7.6. Your answer must have the $AS - AD$ diagram.
   An increase in the price of oil leads, in the short run, to a decrease in output and an increase in the price level. Over time, output decreases further and the price level increases further.

   (b) (4 points) What happens to the unemployment rate in the short run and the medium run?

   Solution: In the short run, unemployment rate will go up. In the medium run, the structural unemployment rate will also go up. You must draw a graph to show what happens in the medium run.

9. (10 points) *In a country called Chintu Rashtra, there are two goods that are very popular amongst consumers- ice cream, and pizza. So, the price level- as you learnt in the lecture- in this economy is determined by these two goods' prices. The price-quantity schedule for years 2017, and 2018 is given below.*

	Ice Cream		Pizza	
	2017	2018	2017	2018
Price	p_1	p_1'	p_2	p_2'
Quantity	q_1	q_1'	q_2	q_2'

   (a) (5 points) Show that the CPI can be written as the weighted average of the prices of two goods.

$$CPI = w_1 \times \tilde{p_1} + w_2 \times \tilde{p_2}$$

   where

$$w_i = \frac{p_i \times q_i}{\sum p_i \times q_i} \qquad i = 1, 2$$

   and

$$\tilde{p_i} = \frac{p_i'}{p_i} \qquad i = 1, 2$$

   Solution: Let's start with the RHS.

$$\begin{aligned} & w_1 \times \tilde{p_1} + w_2 \times \tilde{p_2} \\ & \qquad = \frac{p_1 \times q_1}{\sum p_i \times q_i} \times \left(\frac{p_1'}{p_1}\right) + \frac{p_2 \times q_2}{\sum p_i \times q_i} \times \left(\frac{p_2'}{p_2}\right) \\ & \qquad = \frac{p_1' \times q_1}{\sum p_1 \times q_1} + \frac{p_2' \times q_2}{\sum p_2 \times q_2} \\ & \qquad = CPI \end{aligned}$$

(b) (5 points) Now, assume that $w = w_1$ and the 2018 ice cream price is higher than 2017 price by α percent, and the 2018 pizza price is lower than 2017 price by β percent. Show that the CPI in 2018 would be greater than 1 if only if

$$\frac{\beta}{\alpha + \beta} < w$$

Solution: Collect all the stuff that you need to prove this.
Since $w_1 = w$, therefore $w_2 = 1 - w$.
Let's also derive price changes.

$$\frac{p_1'}{p_1} - 1 = \alpha$$
$$\frac{p_1'}{p_1} = 1 + \alpha$$

and

$$\frac{p_2'}{p_2} - 1 = -\beta$$
$$\frac{p_2'}{p_2} = 1 - \beta$$

If CPI has to be > 1,

$$w_1 \cdot \tilde{p_1} + w_2 \cdot \tilde{p_2} > 1 \tag{5}$$

We need to show this.

$$\begin{aligned}
w_1 \cdot \tilde{p_1} + w_2 \cdot \tilde{p_2} &> 1 \\
w_1 \cdot \frac{p_1'}{p_1} + w_2 \cdot \frac{p_2'}{p_2} &> 1 \\
w_1 \cdot (1 + \alpha) + w_2 \cdot (1 - \beta) &> 1 \\
w \cdot (1 + \alpha) + (1 - w) \cdot (1 - \beta) &> 1 \\
w(\alpha + \beta) + (1 - \beta) &> 1 \\
w(\alpha + \beta) &> \beta \\
w &> \frac{\beta}{\alpha + \beta}
\end{aligned}$$