Introductory text:

School of Business and Economics

Exam: Macroeconomics I
Code: E_EBE1_MACEC

Examinator: Dennis Bonam
Co-reader: Eric Bartelsman

Date: 30 June 2020
Time: 12:15
Duration: 4 hours

Calculator allowed: yes
Graphical calculator allowed: yes
Scrap paper allowed: yes
Open book exam: yes

Answer in: English

Remarks
Time
The exam contains **5 parts**, each part earns **20 points**. The exam **starts at 12:15** and **ends at 16:15**. This means you have to submit your answers before **16:15**. In total, you have 4 hours to take the exam and an extra 30 minutes to upload figures *after* the exam (see below).

Registration
If you have **not** signed up for this exam, you will not receive a result. Through VUnet you can object to the fact that you can no longer sign up after the expiry of the registration deadline (and the fact that you will not receive a result for this exam). Submit your appeal online within one week after the exam. More information can be found at www.vu.nl/intekenen.

Which materials can you use?
It is an **open book** exam, which means that you are allowed to use the following:

- The Mankiw & Taylor book (either in digital or physical form)
- The course slides (either in digital or physical form)
- Your personal notes (either in digital or physical form)
- A (normal or graphical) calculator

During the exam, you are not allowed to use any other material or sources (either in digital or physical form) or work together with other people. You are also not allowed to use a smartphone or tablet.

Uploading pictures
There will be some questions in the exam where you are asked to draw a graph. Please upload a photo of your graph on Canvas *after* you have finished and submitted the exam. Go to Canvas > Assignments > "RESIT: File Upload Re-sit Exam". You can upload multiple files. Please indicate clearly your name, student number and the corresponding question number on the file(s) that you upload. It is not allowed to use a smartphone or upload any files *during* the exam. You have until **16:45** to upload your pictures on Canvas!

Other remarks

- The exam will consist of five parts. Within each part, it is possible to revisit previous questions. However, as soon as you move on to the next part, it will no longer be possible to revisit the questions from the preceding part(s).
- Before providing an answer, make sure you read the full question very carefully!
- Do not accidentally submit your exam before you finish. Once you press “Ready” and "Finish Exam - Yes", it means that you have submitted the exam and you can no longer make any changes to your answers.
- When providing numerical answers, make sure to round your answer as specified in the question. Depending on your operating system, you need to use either a *point* or a *comma* when adding decimals. If you use the wrong symbol Testvision will not accept your answer and should show an error message.
- For some questions, we ask you to write down the calculation steps for your answer in the preceding question. You will see that this type of ‘explanation questions’ has one point. This is for technical reasons only! Always write down your calculation steps when we ask for it, as not showing your calculations will affect your overall grade!

- If you experience technical problems during the exam please contact Proctorio via the online chat in the bottom left corner of TestVision, on the widget or at: https://proctorio.com/support. Accidentally left your exam? You can log back into your exam by going to the TestVision link: https://vu.testvision.nl/online/fe/login_tva.htm

Contact
If you encounter any problems while making the exam or have questions, please send (one of) us an email:

- Dennis Bonam: d.a.r.bonam@vu.nl
- Philipp Kollenda: p.kollenda@vu.nl
- Diego Dabed: ddabed@gmail.com
- Noobar Vartan: noobar.vartan@vu.nl

We will standby to respond to your questions as quickly as possible.

Good luck!

Text on first page of each block:

Important: You can revisit previous questions from the same part, but after you finish this part you will not be able to revisit any question of this part again.

Text on block with question about Solow growth model:

For the following questions, consider the Solow growth model without technological growth (i.e. the level of technology is fixed).

1. General macro concepts (20 points). Multiple choice

i. Which of the following topics are the focus of a macro-economist?
   a. How COVID-19 related "lockdown measures" influence the unemployment rate.
   b. Whether the trade conflict between China and the United States is more harmful to Chinese consumers than to American consumers.
   c. Whether the ECB's monetary policy will lead to inflation in the long-run.
   d. All of the presented answers

Solution: *D.*

ii. One way of calculating total GDP is by using the following formula: $GDP = C + I + G + X - Im$, where C = private consumption, I = investment, G = government spending, X = exports and Im = imports. In which approach to measure GDP is this formula used?
   a. The income approach
   b. The expenditure approach
   c. The transaction approach
   d. The value-added approach

Solution: *B.*

iii. Person A has given a loan to Person B which Person B needs to repay in the next 10 years. Assume that the loan is denoted in nominal terms, which means it is not indexed for inflation. If there is strong deflation in the next ten years, which person would most likely gain from the deflation?
   a. Person A
   b. Person B
   c. Both Person A and Person B
   d. Neither Person A nor Person B

Solution: *A.*

iv. Consider an economy described by the Solow Growth model. The economy is currently in steady state, i.e. capital per worker is constant at k^*. Also, the economy faces a positive population growth rate, i.e. $n > 0$. Which of the following variables or parameters is nevertheless still increasing in steady state?
   a. The economy's total capital stock
   b. The savings rate
   c. The capital depreciation rate
   d. Output per worker

Solution: *A.*

v. Consider an economy with 3 firms. Firm A produces 50 euro worth of output using labor and 25 euro of intermediate inputs. Firm B produces 100 euro worth of output using labor and 25 euro of intermediate inputs. Firm C produces 50 euro of output using only labor, and sells it to the other firms. Which statement is correct?
   a. The value added of the total economy is 150.
   b. The value added of firm C is 0, because it does not use intermediate inputs.
   c. The value added of firm A is 75.
   d. The value added of the total economy is 200.

Solution: *A.*

vi. Consider the following type of labor market policy: The government introduces an online platform to match university graduates to available jobs in their specialization. Which type of unemployment does this policy address?
   a. Frictional unemployment
   b. Seasonal unemployment
   c. Voluntary unemployment
   d. Structural unemployment

Solution: *A.*

vii. Consider the labor market of a country. Assume that 10% of employees lose their jobs every year. Once unemployed, 40% of people find a new job within a year. The size of the labor force is 10 million people. Which of the following statements about the labor market equilibrium is correct?
   a. The unemployment rate is 80%
   b. Total employment is 4 million people
   c. Total unemployment is 2 million people
   d. 4 million people find a job each year

Solution: *C.*

viii. Which of the following does not count as an economic benefit of implementing a single currency among a group of countries:
   a. Increased mobility of residents.
   b. Saving on fees charged by banks to convert currencies.
   c. Increased competition in prices between firms in different countries.
   d. Reduction of exchange rate volatility.

Solution: *A.*

ix. An economy has a monetary base of 2 bln euro. Calculate the money supply if the currency-deposit ratio is 0.2 and banks hold 10 percent of deposits as reserves.
   a. 4 bln euro
   b. 8 bln euro
   c. 0.8 bln euro
   d. 0.25 bln euro

Solution: *B.*

x. Which of the following statements about the GDP deflator is **incorrect**?
   a. The GDP deflator is a Laspeyres index
   b. The GDP deflator is a Paasche index
   c. The GDP deflator includes prices of capital goods
   d. The GDP deflator includes prices of imported goods

Solution: *A.*

2. A classical economy (20 points)

Consider a closed economy described by the following behavioral equations:

$$C = 220 + 0.6(Y - T)$$
$$I = 50 + 0.2Y$$
$$T = 200$$
$$G = 250$$

with C consumption, Y income, I investment, T taxes and G government spending. "*" means "multiplied with". Note that investment does not depend on the interest rate, but depends on income!

a. Compute income, Y, and consumption, C, by solving for the goods market equilibrium. (7 points)

Solution:

$$Y = C + I + G = 220 + 0.6(Y - T) + 50 + 0.2Y + 250$$
$$(1 - 0.6 - 0.2)Y = 520 - 120$$
$$Y = \frac{400}{1 - 0.6 - 0.2} = 2000$$
$$C = 220 + 0.6(2000 - 200) = 1300$$

b. Continuing with the closed economy described in the previous question. Compute [disposable income] OR [public savings] and show your calculations.

Solution:

$$\text{Disposable income} = Y - T = 2000 - 200 = 1800$$
$$S(\text{public}) = T - G = 200 - 250 = -50$$

c. Continuing with the closed economy described in the first question of this block. Compute private savings and show your calculations. (1 point)

Solution:

$$S(\text{private}) = Y - T - C = 2000 - 200 - 220 - 0.6(2000 - 200) = 500$$

d. Continuing with the closed economy described in the first question of this block. The government aims to stimulate the economy by raising government consumption by $\Delta G = 50$. Following this fiscal expansion, compute the new level of national income, Y_{new}, and consumption, C_{new}. Show your calculation steps. (7 points)

Solution:

$$\Delta Y = \Delta C + \Delta I + \Delta G = 0.6\Delta Y - 0.6\Delta T + 0.2\Delta Y + 50$$
$$\Delta Y = \frac{1}{1 - 0.6 - 0.2}50 = 250$$
$$Y_{new} = 2250$$
$$C_{new} = 220 + 0.6(2250 - 200) = 1450$$

e. Continuing with the closed economy described in the first question of this block. Consider the increase in government expenditure mentioned in the previous question. **Question**: Calculate the government spending multiplier and show your calculation steps. (2 points)

Solution: *Government spending multiplier* $= 1/(1 - 0.6 - 0.2) = 5$

f. Continuing with the closed economy described in the first question of this block. If, due to the corona crisis, people wish to save a greater portion of their income, how would this affect the government spending multiplier calculated in the previous question? (1 point)
   i. The multiplier would go up
   ii. The multiplier would go down
   iii. The multiplier would stay the same

Solution: *(ii).*

3. **Economic growth (20 points)**

Use the Solow model for these questions.

a. Use the Solow model for these questions. Which of the equations below shows the dynamics of the stock of capital per worker in the Solow model? Assume population growth is zero, i.e. n = 0. [In the equations below, " ^ " means "to the power of", " * " means "multiplied with", " / " means "divided by" and f(x) means "some function of x"]? (1 points)

   i. $y = k^{\alpha}$
   ii. $\Delta k = sf(k) - \delta k$
   iii. $k = \left(\frac{s}{\delta}\right)^{\alpha}$
   iv. $k = (1 - s)f(k)$

Solution: *(ii)*

b. Use the Solow model for these questions. Which flows **have to be** equal, such that an economy described by the Solow model and without population growth, is in steady state? (1 point)

   i. Investment = depreciation
   ii. Savings = investment
   iii. Capita = income
   iv. Savings = consumption
   v. Investment = consumption

Solution: *(i)*

c. Assume that the per-worker production function is given by $y = k^{0.5}$ ("k to the power of 0.5"), where y is output per worker and k is capital per worker. Also assume that the savings rate is $s = 0.4$, the depreciation rate is $\delta = 0.2$ and there is no population growth, i.e. $n = 0$. 1) Calculate the steady-state capital per worker, k^*, 2) Calculate the steady state output per worker, y^*, 3) What is the marginal product of capital, MPK^*, in the steady state? Show your calculation steps. [Hint: You should get a numerical value for each of the three questions.] (8 points)

Solution:

Steady-state capital per worker:

$$sf(k^*) = \delta k^* \Leftrightarrow 0.4(k^*)^{0.5} = 0.2k^* \Leftrightarrow 2 = (k^*)^{0.5} \Leftrightarrow k^* = 4$$

Steady-state output per worker:

$$y^* = (k^*)^{0.5} = 4^{0.5} = 2$$

Steady-state marginal product of capital per worker:

$$MPK^* = 0.5\frac{y^*}{k^*} = 0.25$$

d. Continuing with the previous question. What happens to steady-state output per worker, y^*, when the savings rate increases permanently? Explain your answer. (5 points)

Solution: *Higher savings, k accumulates, y rises to new higher steady state.*

e. Continuing with the previous question. What happens to consumption per worker in the **short run** after an increase in the savings rate? (1 point)
   i. Consumption per worker increases gradually in the short run.
   ii. Consumption per worker increases suddenly in the short run.
   iii. Consumption per worker decreases gradually in the short run.
   iv. Consumption per worker decreases suddenly in the short run.
   v. Consumption per worker remains unchanged in the short run.

Solution: *(iv)*

f. Continuing with the previous question. Following the increase in the savings rate, what happens to consumption per worker in the **long run** in each of the three scenarios listed below? (4 points)
   i. If $s_{new} < s_{gold}$ and $s_{old} < s_{gold}$, then the new steady-state consumption per worker will be higher than before
   ii. If $s_{new} > s_{gold}$ and $s_{old} > s_{gold}$, then the new steady-state consumption per worker will be lower than before
   iii. If $s_{new} > s_{gold}$ and $s_{old} < s_{gold}$, then the new steady-state consumption per worker will be higher or lower than before, but we don't know exactly

This was a matching question in Testvision. All statements above are true.

4. The IS-LM and Mundell-Fleming model (20 points)

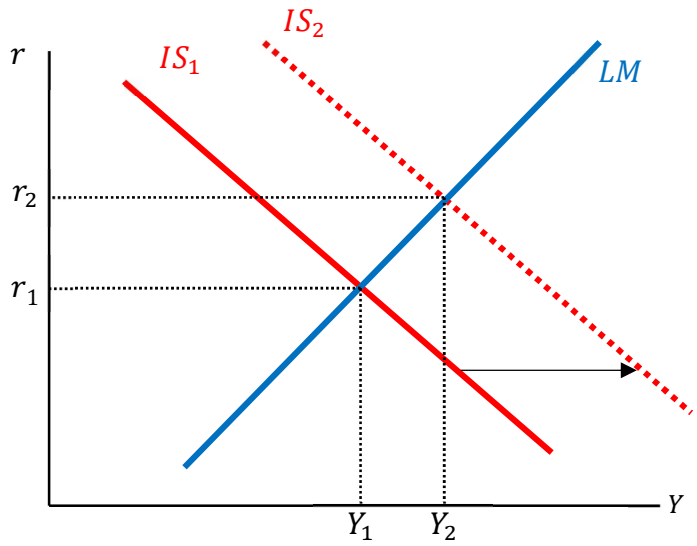
a. **NOTE**: For this question, you need to draw a graph and upload a picture! More information is provided below.

Consider a closed economy. The government wishes to stimulate the economy by raising government spending. Draw the IS- and LM-curves and show what happens to income, Y, its components, C and I, and the interest rate, r (use + ,-, =. For example: Y=, C+, I-, ...). Show how the IS-curve and/or LM-curve shift(s) following the rise in government spending. Consider the standard model in which investment depends only on the interest rate.

INSTRUCTIONS: Please take a picture of your answer and upload the file on Canvas. Go to Assignments > RESIT: File Upload Re-sit Exam. Please make sure the drawing is clearly readable and visible. Remember to label the curves and the axes and write down your name and student number on the drawing.

IMPORTANT: In order for us to be able to assign you points, **you need to fill in your name in the text box below**! If you keep the text box empty, we won't be able to assign any points to you! (6 points)

Solution:



Y goes up, C goes up, I goes down, r goes up.

b. Continuing from the previous questions. How would the effect on [output, Y] OR [the interest rate, r], due to the increase in government spending be different if the central bank intervened to keep [the interest rate constant] OR [output constant]. (2 points)

i. The effect on output/the interest rate would be stronger
ii. The effect on output/the interest rate would be weaker
iii. The effect on output/the interest rate would be the same

Solution: *Interest rate constant: output would increase by more than under a)*
Output constant: interest rate rises by more than under a)

c. Consider a small open economy described by free capital mobility, flexible exchange rates, and the following behavioral equations:

$$\begin{aligned} C &= 100 + 0.2(Y - T) \\ I &= 100 + 0.2Y - 240r \\ IM &= 0.02Y + 20e \\ X &= 0.1Y - 60e \\ T &= 50 \\ G &= 50 \\ M^s &= 200 \\ M^d &= Y - 3600i \end{aligned}$$

with C consumption, I investment, IM imports, X exports, T taxes, G government spending, M^s money supply, M^d money demand, Y national income, e the exchange rate, i the domestic interest rate and r the world interest rate. " * " means "times" or "multiplied by". Note that, in this economy, investment depends on *both* the interest rate and on income!

Assume that the economy commits to having an external trade balance equal to zero.

Write down the equation for the IS-curve and the LM-curve. [**Hint**: For both curves, output should be a function of only the world interest rate] (2 points, OE)

Solution: *IS curve:*

$$\begin{aligned} Y &= C + I + G + X - IM \\ &= 100 + 0.2(Y - 50) + 100 + 0.2Y - 240r + 50 \\ Y &= 400 - 400r \end{aligned}$$

LM curve, imposing $i = r$:

$$\begin{aligned} M^s &= M^d \\ 200 &= Y - 3600r \\ Y &= 200 + 3600r \end{aligned}$$

d. Continuing from the preceding question. Compute the world interest rate, r, national income, Y, and the exchange rate, e, that satisfy equilibrium in the goods market *and* the money market. Show your calculation steps. [Hint: Start by equating the IS- and LM-curves. You should be able to obtain numerical values for r, Y and e.] (4 points)

Solution: *Equate:*

$$400 - 400r = 200 + 3600r$$

Compute r*:*

$$r = 0.05$$

Compute Y*:*

$$Y = 400 - 400 * 0.05 = 380$$

Compute e*:*

$$X = IM$$
$$0.1Y - 60e = 0.02Y + 20e$$
$$e = 0.38$$

e. Consider a small open economy with flexible exchange rates and free capital mobility. Using the IS*-LM* model, answer what happens to the exchange rate (e), income (Y) and the trade balance (NX) in the short run. Consider the standard model in which investment depends only on the interest rate. In all of the fields below, select either "decreases", "increases" or "remains constant". (6 points)

	e	***Y***	***NX***
i. To prevent inflation from falling, the central bank raises the money supply.			
ii. Disruption in global supply chains causes a fall in imports.			
iii. Due to increased uncertainty, firms cut back on investment.			
iv. To prevent an increase in unemployment, the government raises its consumption expenditures.			

Solution:

	e	***Y***	***NX***
i. To prevent inflation from falling, the central bank raises the money supply.	-	+	+
ii. Disruption in global supply chains causes a fall in imports.	+	=	=
iii. Due to increased uncertainty, firms cut back on investment.	-	=	+
iv. To prevent an increase in unemployment, the government raises its consumption expenditures.	+	=	-

5. The AS-AD model (20 points)

a. Consider a closed economy. Using the AS-AD model, describe what happens after the government reduces taxes. What happens to output, Y, and the price level, P, of the economy in the short run? What happens to Y and P in the long run? (7 points)

Solution: *Short run: G up; AD curve shifts right; Y and P go up. Long run: P goes up; real money supply falls; Y falls; AS curve moves up.*

b. Consider the sticky-price model of aggregate supply. Imagine an expansionary monetary policy such that the money supply increases. Assume two different scenarios:
   1) $P^e \neq P$, i.e. expectations about the price level, P^e, can differ from the actual price level, P
   2) $P^e = P$, i.e. expectations about the price level, P^e, are always equal to the actual price level, P

   How does the slope of the AS curve differ between the two scenarios? Also, describe the short-run effects of the monetary policy shock on output, Y, and prices, P, in both scenarios. (7 points)

Solution: *Scenario 1: AS upward sloping; MP has real effects; AD curve shifts right; $Y \uparrow$; $P \uparrow$ Scenario 2: AS vertical; AD curve shifts right; only $P \uparrow$; $\Delta Y = 0$.*

c. Consider a closed economy in which the AS curve is determined by the sticky-wage model. Suppose there is an increase in government spending. What is the short-run effect on output, Y, and the price level, P? What does the empirical evidence say about the correlation between output, Y, and real wages, W/P? (6 points)

Solution: *$G \uparrow$; AD curve shifts right; $Y \uparrow$; $P \uparrow$; $\frac{W}{P} \downarrow$; $L \uparrow$; $Y \uparrow$, so output and prices both go up. Real wages fall as output goes up, which is inconsistent with the data.*