

TOTAL SCORE _____

MC _____

EXE 1 _____

EXE 2 _____

Econ 002 – INTRO MACRO – Prof. Luca Bossi – March 23, 2015

MIDTERM #2 SUGGESTED SOLUTIONS

My signature below certifies that I have complied with the University of Pennsylvania's Code of Academic Integrity in completing this examination. In particular, I declare that I have not used a graphing calculator to complete this exam.

Student Name (printed)

PennID

Your Signature

Date

Your TA Name (printed)

INSTRUCTIONS

The exam is closed book. The exam is composed of 21 multiple choice questions and two exercises. Unless stated otherwise, all multiple choice questions are worth 3 points (the total is 60 points for the multiple choice part). The exercises are worth 20 points each (the total is 40 points for the exercise part). You can detach the answer sheet for the MC part at the end of the exam if this is more comfortable for you. If that is the case, be sure to put your name on it and to tell your TA to staple it back to the exam when finished. If you do not fill in the MC part on time and request extra time at the end of the exam to write the answers up, a proctor will take your name and you will receive a penalty of 5 points. Please follow the instructions as to how to submit your exam at the end of the 60 minutes. If you do not follow those instructions and/or delay your exam submission, a proctor will take your name and you will receive a penalty that will depend on your (miss)behavior.

ANSWER ALL QUESTIONS. TOTAL POINTS = 100. TOTAL TIME = 60 minutes

Provide your answers on the exam sheet directly. Read all questions very carefully. Write legibly.

EXAM TAKING POLICY

If you need to use the restroom, raise your hand and wait for the proctor to come to you. Only one person can be out of the examination room at a time, and the proctor will hold onto your exam papers while you are out at the restroom.

FOR THE DURATION OF THE EXAM, AND WITH THE EXCEPTION OF YOUR ALLOWED SCIENTIFIC CALCULATOR, YOU HAVE TO TURN OFF EVERYTHING ELSE THAT HAS A POWER BUTTON. NO CELL PHONES. NO BOOKS. NO NOTES. NO HELP SHEETS. NO TALKING TO EACH OTHER. NO ASKING THE PROCTORS ANY QUESTION OR HELP TO SOLVE THE EXAM. YOU CANNOT CONNECT TO THE INTERNET.

WRITE IN PENCIL OR IN PEN AS YOU LIKE, BUT IF YOU WRITE IN PENCIL THERE IS NO POSSIBILITY TO ASK FOR RE-GRADING. PLEASE WRITE YOUR NAME ON THE FIRST PAGE OF THE EXAM AND ON THE MC BUBBLE PAGE.

PLEASE DO NOT START THIS EXAM UNTIL INSTRUCTED TO DO SO.

GOOD LUCK!

MULTIPLE CHOICE QUESTIONS

Identify the letter that best completes the statement or answers the question. Mark your answer (fill in the letter of your choice) in the answer bubble sheet for the MC provided on the last page of the exam.

- 1) If a Brazilian company opens a new factory in Peru, it makes
- foreign direct investment. The factory will make a bigger impact on Peru's GDP than on its GNP.
 - foreign direct investment. The factory will make a bigger impact on Peru's GNP than on its GDP.
 - foreign portfolio investment. The factory will make a bigger impact on Peru's GDP than on its GNP.
 - foreign portfolio investment. The factory will make a bigger impact on Peru's GNP than on its GDP.
- 2) If Germany goes from a small budget deficit to a large budget deficit, it will reduce
- private saving and so shift the supply of loanable funds left.
 - investment and so shift the demand for loanable funds left.
 - public saving and so shift the supply of loanable funds left.
 - None of the above is correct.
- 3) Which of the following events could explain a decrease in interest rates together with an increase in investment?
- The government went from surplus to deficit.
 - The government reduced the tax rate on savings.
 - The government instituted an investment tax credit.
 - None of the above is correct.
- 4) In 2009, Modern Electronics, Inc. produced 60,000 calculators, employing 80 workers, each of whom worked 8 hours per day. In 2010, the same firm produced 76,500 calculators, employing 85 workers, each of whom worked 10 hours per day. Productivity, in terms of output per hours, at Modern Electronics
- decreased by 4%
 - remained constant.
 - increased by 8.33%
 - increased by 27.50%
- 5) People who buy newly issued stock in a corporation such as Crate and Barrel provide
- debt finance and so become part owners of Crate and Barrel.
 - debt finance and so become creditors of Crate and Barrel.
 - equity finance and so become creditors of Crate and Barrel.
 - equity finance and so become part owners of Crate and Barrel.
- 6) Consider three imaginary countries. In Mainland, national saving amounts to \$4,000 and consumption amounts to \$8,000; in Upland, national saving amounts to \$2,000 and consumption amounts to \$15,000; and in Lowland, national saving amounts to \$6,000 and consumption amounts to \$11,000. The national saving rate is
- higher in Mainland than in Lowland, and it is higher in Lowland than in Upland.
 - higher in Lowland than in Mainland, and it is higher in Mainland than in Upland.
 - higher in Lowland than in Upland, and it is the same in Upland and Mainland.
 - higher in Mainland than in Upland, and it is the same in Mainland and Lowland.

7) In 2009, the imaginary nation of Dorados had a population of 8,000 and real GDP of 3,000,000. During the year its real GDP per capita grew by about 2.9%. Which of the following sets of growth rates is consistent with this growth in real GDP?

- a. 2% population growth and 6% real GDP growth
- b. 6% population growth and 2% real GDP growth
- c. 4% population growth and 7% real GDP growth
- d. 7% population growth and 4% real GDP growth

8) Suppose a country imposes new restrictions on how many hours people can work. The production function for this country is Constant Return to Scale. If these restrictions reduce the total number of hours worked in the economy, but all other factors that determine output are held fixed, then

- a. productivity and output both rise.
- b. productivity rises and output falls.
- c. productivity falls and output rises.
- d. productivity and output fall.

9) Which of the following is consistent with the catch-up effect?

- a. The United States had a higher growth rate before 1900 than after.
- b. After World War II the United States had lower growth rates than war-ravaged European countries.
- c. Although the United States has a relatively high level of output per person, its growth rate is rather modest compared to some countries.
- d. All of the above are correct.

10) Productivity

- a. is nearly the same across countries, and so provides no help explaining differences in the standard of living across countries.
- b. explains very little of the differences in the standard of living across countries.
- c. explains some, but not most of the differences in the standard of living across countries.
- d. explains most of the differences in the standard of living across countries.

11) Some poor countries appear to be falling behind rather than catching up with rich countries. Which of the following could explain the failure of a poor country to catch up?

- a. The poor country has outward-oriented trade policies.
- b. The poor country allows foreign direct investment.
- c. The poor country has poorly developed property rights.
- d. All of the above are correct.

12) Compared to short-term bonds, other things the same, long-term bonds generally have

- a. more risk and so they pay higher interest rates.
- b. less risk and so they pay lower interest rates.
- c. less risk and so they pay higher interest rates.
- d. about the same risk and so they pay about the same interest rate.

13) If Research in Motion, Inc. sells a bond it is

- a. borrowing directly from the public.
- b. borrowing indirectly from the public.
- c. lending directly to the public.
- d. lending indirectly to the public.

14) For a closed economy, GDP is \$11 trillion, consumption is \$7 trillion, taxes are \$3 trillion and the government runs a surplus of \$1 trillion. What are private saving and national saving?

- a. \$1 trillion and \$2 trillion, respectively
- b. \$1 trillion and \$1 trillion, respectively
- c. \$4 trillion and \$1 trillion, respectively
- d. \$4 trillion and \$5 trillion, respectively

15) Suppose a country has a consumption tax that is similar to a state sales tax. If its government were to eliminate the consumption tax and replace it with an income tax that includes an income tax on interest from savings, what would happen?

- a. There would be no change in the interest rate or saving.
- b. The interest rate would decrease and saving would increase.
- c. The interest rate would increase and saving would decrease.
- d. None of the above is correct.

16) Suppose you will receive \$500 at some point in the future. If the annual interest rate is 7.5 percent, then the present value of the \$500 is

- a. \$411.26 if the \$500 is to be received in 5 years and \$338.95 if the \$500 is to be received in 10 years.
- b. \$348.28 if the \$500 is to be received in 5 years and \$242.60 if the \$500 is to be received in 10 years.
- c. \$291.11 if the \$500 is to be received in 5 years and \$272.89 if the \$500 is to be received in 10 years.
- d. \$291.11 if the \$500 is to be received in 5 years and \$236.49 if the \$500 is to be received in 10 years.

17) A measure of the volatility of a variable is its

- a. present value.
- b. future value.
- c. return.
- d. standard deviation.

18) The utility function of a risk-averse person has a

- a. positive slope and gets steeper as wealth increases.
- b. positive slope but gets flatter as wealth increases.
- c. negative slope but gets steeper as wealth increases.
- d. negative slope and gets flatter as wealth increases.

19) Suppose that Albert can buy a bond for \$1,000 that matures in two years and pays Albert \$1,102.5 with certainty. He is indifferent between this bond and one that has some risk but on which the interest rate is 3 percentage points higher. How much, to the nearest penny, does the riskier bond pay in two years?

- a. \$1,160.00
- b. \$1,169.64
- c. \$1,168.65
- d. \$1,166.40

20) (2 POINTS) According to the assigned reading/video I gave you: “**Playing Without Protection: Solving Football's Concussion Crisis**” to reduce Moral Hazard and injuries to players the NFL should

- a. **Ditch the helmets.**
- b. Ditch cleats.
- c. Ditch shoulder pads.
- d. Ditch mouth guards.

21) (1 POINT) We studied the Solow model. In class, Professor Bossi mentioned that Robert Solow won the Nobel prize in Economics precisely for this model. He also mentioned in class the year in which this prize was awarded to Solow. The year was:

- a. 1967.
- b. 1977.
- c. **1987.**
- d. 1997.

To get full credits in the exercises below you really need to show your work. If you write just a number as the answer and even if that number is correct you will not get full credits in the exercise unless you show fully the formulas and your work (how you got that number and the reasoning involved in your computation).

EXERCISE I (20 points)

Use 2 decimals for your computations.

In the city of Townsville, the current year's debt, B_t , is 20,000, current year's transfers are 1,500 and current year's government spending is 2,000. You are told that Townsville's GDP has grown by 15% from the past year and that the current real interest rate is 8%. The tax revenues for the current year are 2,500 and the current year's GDP is 25,000. The current population is 7,500.

a) (6 POINTS) Assuming that the current inflation rate is zero, what is the ratio of debt to GDP for the previous year?

b) (7 POINTS) For next year, you now know that the city's government spending is going to be 12% of the economy's next year GDP. The city's tax revenues and transfers will grow by 10% from the previous year and the city's GDP will double from the previous year. Assuming that the real interest rate hasn't changed and that there is no inflation, what is the next year's debt?

c) (7 POINTS) Assume that the real interest rate has not changed. In period $t+2$, the debt per person is 3.5. You also know that the population growth rate is constant at 7.5% per year and that the city's GDP has grown by 5% from the previous year. If the government's deficit is now 10% of its GDP, what is the inflation rate for period $t+2$?

PAPER FOR YOUR USE

Answers:

a) Recall the definition of budget debt:

$$B_t = DE_t + (1 + i)B_{t-1} = (G_t + Tr_t - T_t) + (1 + i)B_{t-1}$$

We can solve for the previous year's debt:

$$20,000 = (2,000 + 1,500 - 2,500) + (1 + 0.08)B_{t-1}$$

(Please note that $i = r$ since inflation is zero!)

$$\text{Therefore, } B_{t-1} = 17,592.59$$

We also know that the economy's output has grown by 15% so we can find the city's GDP for the previous year:

$$Y_t = (1 + g_Y)Y_{t-1}$$

(where g_Y is the growth rate of the GDP)

$$25,000 = (1 + 0.15)Y_{t-1}$$

$$Y_{t-1} = 21,739.13$$

$$\text{Therefore } B_{t-1}/Y_{t-1} = 17,592.59/21,739.13 = 0.81 \rightarrow 81\%$$

b) Since the government's spending is 12% of its GDP, we know that:

$$G_{t+1} = 0.12Y_{t+1} = 0.12[2Y_t] = 0.12(2 * 25,000) = 6,000$$

We also know that the city's tax revenue and transfers have grown by 10%:

$$T_{t+1} = (1 + 0.1)T_t = 1.1 * 2,500 = 2,750$$

$$Tr_{t+1} = (1 + 0.1)Tr_t = 1.1 * 1,500 = 1,650$$

So for the following year's budget debt, we would have:

$$B_{t+1} = DE_{t+1} + (1 + i)B_t = (G_{t+1} + Tr_t - T_{t+1}) + (1 + i)B_t$$

$$B_{t+1} = (6,000 + 1,650 - 2,750) + (1 + 0.08)20,000 = 26,500$$

c) We know that:

$$B_{t+2}/Pop_{t+2} = 3.5$$

We also know that the population has grown at a rate of 7.5% per year, so we would get:

$$Pop_{t+2} = (1 + 0.075)^2 * 7,500 = 8,667.19$$

$$\text{Therefore, } B_{t+2} = 3.5 * Pop_{t+2} = 3.5 * 8,667.19 = 30,335.17$$

Since the government's deficit is 10% of its GDP, we would obtain:

$$DE_{t+2} = 0.1[(1 + 0.05) * (2 * 25,000)] = 5,250$$

And now, we can solve for inflation. (Don't forget that $i = r + \pi$)

$$B_{t+2} = DE_{t+2} + (1 + i)B_{t+1}$$

$$30,335.17 = 5,250 + (1 + (0.08 + \pi))26,500$$

$$30,335.17 = 5,250 + (1.08 + \pi)26,500$$

Therefore, $\pi = -0.13 \rightarrow -13\%$ (So this means that there's deflation)

EXERCISE II (20 points total)

Consider the Solow model we have seen and studied in class. Assume that the production function is given by the following expression

$$Y_t = A * F(K_t, L_t) = A[\alpha K_t^\rho + (1 - \alpha)L_t^\rho]^{\frac{1}{\rho}}$$

Where $A > 0$ is TFP, L is labor and K is capital. The other parameters are restricted to be: $0 < \alpha < 1$, $\rho \leq 1$.

a) (5 POINTS) Write down the 5 basic equations that characterize the Solow model in this case.

b) (10 POINTS) Let $\alpha = \rho = 0.5$, $s = 0.05$, $A = 1$, $n = 0.03$, $d = 0.02$ Find the value for the steady state level of physical capital per person. Show your work.

c) (5 POINTS) We now want to introduce a government in this Solow model. In particular, we assume all the production/income in the economy is taxed at a certain constant tax rate τ in each period. Assume that the government not only taxes, but also offers productive government spending that enhances total production in the economy. Think of this as the services coming from general infrastructures, public schools, police, firemen, army etc.. This being the case, the new production function for our economy now is:

$$Y_t = A * F(K_t, L_t, G_t) = A[\alpha K_t^\rho + \beta L_t^\rho + (1 - \alpha - \beta)G_t^\rho]^{\frac{1}{\rho}}$$

with $0 < \alpha + \beta < 1$, $\alpha > 0$, $\beta < 1$, $\rho \leq 1$. And where G_t is government spending. Suppose that the government is running a balanced budget every period and that there are no transfers.

If you know that $K_t = 16$, $L_t = 4$, $\alpha = \rho = 0.5$, $\beta = 0.4$, $A = 1$, $\tau = 0.1$ what is total income/output of equilibrium? Show your work. Use 3 decimals for your computations. (Hint: this part does not require you to derive the fundamental equation of the Solow model, nor the steady state).

PAPER FOR YOUR USE

Answers

a) The five equations that define the Solow model now are

$$\begin{aligned} 1) Y_t &= A[\alpha K_t^\rho + (1 - \alpha)L_t^\rho]^{\frac{1}{\rho}} \\ 2) S_t &= sY_t \\ 3) I_t &= S_t \\ 4) K_{t+1} &= I_t + (1 - d)K_t \\ 5) L_{t+1} &= (1 + n)L_t \end{aligned}$$

b) Output per person in this case is:

$$\frac{Y_t}{L_t} = \frac{A[\alpha K_t^\rho + (1 - \alpha)L_t^\rho]^{\frac{1}{\rho}}}{L_t}$$

We need to work some algebra to obtain a nicer expression to work with:

$$Y_t = A[\alpha K_t^\rho + (1 - \alpha)L_t^\rho]^{\frac{1}{\rho}}$$

So

$$\begin{aligned} Y_t^\rho &= A[\alpha K_t^\rho + (1 - \alpha)L_t^\rho] \\ \frac{Y_t^\rho}{L_t^\rho} &= \frac{A[\alpha K_t^\rho + (1 - \alpha)L_t^\rho]}{L_t^\rho} \\ \left(\frac{Y_t}{L_t}\right)^\rho &= A\left[\alpha\left(\frac{K_t}{L_t}\right)^\rho + (1 - \alpha) * 1\right] \end{aligned}$$

And then output per person in this case is:

$$\frac{Y_t}{L_t} = A \left[\alpha \left(\frac{K_t}{L_t} \right)^\rho + (1 - \alpha) * 1 \right]^{\frac{1}{\rho}}$$

With the small caps convention to denote per capita variables, the expression above becomes:

$$y_t = A[\alpha(k_t)^\rho + (1 - \alpha)]^{\frac{1}{\rho}}$$

Using the expression of output per capita you can derive with the usual procedure the fundamental equation with the small caps convention that represent per capita variables:

$$k_{t+1}(1 + n) = sy_t + (1 - d)k_t$$

$$k_{t+1}(1 + n) = sA[\alpha(k_t)^\rho + (1 - \alpha)]^{\frac{1}{\rho}} + (1 - d)k_t$$

In steady state we know that:

$$k_{t+1} = k_t = \bar{k}$$

Plug this into the fundamental equation to obtain:

$$0 = sA[\alpha(\bar{k})^\rho + (1 - \alpha)]^{\frac{1}{\rho}} - (n + d)\bar{k}$$

Solving for \bar{k}

$$\begin{aligned} sA[\alpha(\bar{k})^\rho + (1 - \alpha)]^{\frac{1}{\rho}} &= (n + d)\bar{k} \\ s^\rho A^\rho [\alpha(\bar{k})^\rho + (1 - \alpha)] &= (n + d)^\rho \bar{k}^\rho \\ ((n + d)^\rho - s^\rho A^\rho \alpha) \bar{k}^\rho &= s^\rho A^\rho (1 - \alpha) \\ \bar{k} &= \left(\frac{s^\rho A^\rho (1 - \alpha)}{((n + d)^\rho - s^\rho A^\rho \alpha)} \right)^{\frac{1}{\rho}} \end{aligned}$$

Substituting the values we are given:

$$\bar{k} = \left(\frac{0.05^{0.5} 1^{0.5} (1 - 0.5)}{((0.03 + 0.02)^{0.5} - 0.05^{0.5} 1^{0.5} 0.5)} \right)^{\frac{1}{0.5}} = 1$$

c) Now the five equations are (equation 1) has changed):

$$\begin{aligned} 1) Y_t &= A[\alpha K_t^\rho + \beta L_t^\rho + (1 - \alpha - \beta)G_t^\rho]^{\frac{1}{\rho}} \\ 2) S_t &= s(1 - \tau)Y_t \\ 3) I_t &= S_t \\ 4) K_{t+1} &= I_t + (1 - d)K_t \\ 5) L_{t+1} &= (1 + n)L_t \end{aligned}$$

To these we need to add also the equation for the balanced budget

$$6) G_t = T_t = \tau Y_t$$

Substitute 6) into 1):

$$Y_t = A[\alpha K_t^\rho + \beta L_t^\rho + (1 - \alpha - \beta)(\tau Y_t)^\rho]^{\frac{1}{\rho}}$$

Solve for Y_t :

$$\begin{aligned} Y_t^\rho &= A^\rho [\alpha K_t^\rho + \beta L_t^\rho + (1 - \alpha - \beta)\tau^\rho Y_t^\rho] \\ Y_t^\rho (1 - A^\rho (1 - \alpha - \beta)\tau^\rho) &= A^\rho [\alpha K_t^\rho + \beta L_t^\rho] \end{aligned}$$

$$Y_t^\rho = \frac{A^\rho[\alpha K_t^\rho + \beta L_t^\rho]}{(1 - A^\rho(1 - \alpha - \beta)\tau^\rho)}$$

$$Y_t = \left\{ \frac{A^\rho[\alpha K_t^\rho + \beta L_t^\rho]}{(1 - A^\rho(1 - \alpha - \beta)\tau^\rho)} \right\}^{\frac{1}{\rho}}$$

Substituting the values we are given:

$$Y_t = \left\{ \frac{1^{0.5}[0.5 * 4 + 0.4 * 2]}{(1 - 1^{0.5} * (1 - 0.5 - 0.4)0.1^{0.5})} \right\}^{0.5} = 8.367$$

MARK CLEARLY (FILL IN) THE LETTER OF YOUR CHOICE FOR THE MULTIPLE CHOICE QUESTIONS ONLY THIS PAGE WILL BE GRADED FOR THE MC PART.

- | | | | | |
|-----|---|---|---|---|
| 1. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 2. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 3. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 4. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
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| 10. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 11. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 12. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
| 13. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
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| 20. | Ⓐ | Ⓑ | Ⓒ | Ⓓ |
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