

ECON 102 - Winter 2016  
Instructor: François Geerolf

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Student ID (UID): \_\_\_\_\_

Final Exam  
March 17, 2016

Signature: \_\_\_\_\_

Time Limit: 180 Minutes

TA Name: \_\_\_\_\_

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## Test A

This exam contains 26 pages, including this cover page and **4 pages of scratch paper** at the end. The time limit is **180 Minutes**. You can earn 100 points. There are 40 multiple choice questions, worth 1 point each. There are then 30 short answer questions, worth 2 points each, divided in three problems.

### Instructions:

1. Print your Last name, First Name, Student ID Number, Signature, and TA Name (Flavien Moreau, Giovanni Nicolo, Santiago Justel, or Shuo Liu) at the top right-hand corner of this page, as well as on your scantron.
2. The only items that should be on your desk are pencils and/or pens, a Scantron 882-E, and the calculator Canon LS-100TS, described in the syllabus. NO other items are allowed.

**Good luck. Budget your time wisely. (skip the question or even the exercise if you get stuck)**

Grade Table (FOR GRADER USE ONLY)

Question	Points	Score
A	40	
B	20	
C	20	
D	20	
Total:	100	

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## Multiple Choice (40 pts)

- A. (40 pts) There are 40 multiple choice questions. **Multiple responses may be correct, and at least one response is correct.** Use your scantron (Results not reported on the scantron will not be taken into account). Again, write your first and last name on the scantron. You get either 0 or 1 point: if multiple answers are correct you get the one point only if you have them all ticked.
- 

- (1) (1 pt) What is an endogenous variable?
- A. An input that can change over time, but determined ahead of time by the model builder.
  - B. An outcome of the model.
  - C. An input that is fixed over time, except when the model builder changes it for an experiment.
  - D. Total factor productivity in the Solow model.
  - E. The stock of capital in the Solow model.
- 

- (2) (1 pt) What was per capita GDP growth in the United States over 1870-2012?
- A. 1.5%
  - B. 2%
  - C. 2.5%
  - D. 3%
  - E. 3.5%
- 

- (3) (1 pt) What was GDP growth in the United States over 1870-2012?
- A. 0.5%
  - B. 1.5%
  - C. 2.5%
  - D. 3.5%
  - E. 4.5%
- 

## Long Run

- (4) (1 pt) Suppose a worker replaces his computer with a better one; this would:
- A. decrease the nominal wage
  - B. increase the marginal product of labor
  - C. increase total factor productivity
  - D. increase the amount of leisure demanded
  - E. None of these answers are correct

- (5) (1 pt) In the Solow model, the level of GDP per capita is:
- A. A parameter.
  - B. An exogenous variable.
  - C. An endogenous variable.
  - D. Constant always.
  - E. Constant in the long run.
- 
- (6) (1 pt) What are the three different approaches for measuring GDP?
- A. The production approach.
  - B. The nominal approach.
  - C. The expenditure approach.
  - D. The income approach.
  - E. The profit approach.
- 
- (7) (1 pt) In the Solow model, if we assume that capital depreciation rates are the same across all countries, differences in per capita output can be explained by:
- A. the steady state capital stock.
  - B. the initial capital stock and saving rates.
  - C. differences in productivity and saving rates.
  - D. the labor stock and saving rates.
  - E. None of these answers are correct.
- 
- (8) (1 pt) In the Solow model, once the economy reaches a steady state:
- A. per capita output is constant, but per capita capital is not
  - B. per capita capital is variable
  - C. per capita consumption continues to grow
  - D. per capita consumption is constant.
  - E. per capita consumption is growing.
- 
- (9) (1 pt) In the Solow model, if the share of capital in production is  $1/3$ , and if the productivity of country A is about four times as large as the productivity in country B, and the savings rate of country A is about twice as large as the savings rate in country B then in the steady state output of country A is approximately:
- A. 5 times as large as in country B.
  - B. 7 times as large as in country B.
  - C. 9 times as large as in country B.
  - D. 11 times as large as in country B.
  - E. 13 times as large as in country B.
-

**Short Run**

- (10) (1 pt) When we add the financial friction to the AD curve it:
- A. is represented by a downward movement along the AD curve
  - B. is represented by a downward movement along the AS curve
  - C. shifts the AD curve down
  - D. shifts the AS curve up
  - E. has no impact on the AD curve.
- 
- (11) (1 pt) "DSGE" stands for:
- A. deterministic simulated generalized estimation.
  - B. demand supply general estimation.
  - C. dynamic stationary generated equilibrium.
  - D. dynamic stochastic general equilibrium.
  - E. demand and supply of government expenditures.
- 
- (12) (1 pt) Consider the consumption function  $C_t/\bar{Y}_t = \bar{a}_c + \bar{x}\tilde{Y}_t$ . If the marginal propensity to consume is  $\bar{x} = 25\%$ , then a 3 percent positive demand shock:
- A. raises short-run output by 0.75 percent
  - B. raises short-run output by 2.25 percent
  - C. raises short-run output by 4 percent
  - D. raises short-run output by 5 percent
  - E. has no impact on short-run output
- 
- (13) (1 pt) With adaptive expectations, the Phillips curve can be written as:
- A.  $\Delta\pi_t = \pi_{t-1} + \bar{n}u\tilde{Y}_t$
  - B.  $\Delta\pi_t = \bar{\nu}u_t$
  - C.  $\pi_t = \pi_{t-1} + \bar{\nu}\tilde{Y}_t + \bar{o}$
  - D.  $\pi_t = \pi_{t-1}$
  - E.  $\Delta\pi_t = \bar{\nu}\tilde{Y}_t + \bar{o}$
- 
- (14) (1 pt) Which of the following best describes why the aggregate demand curve slopes downward ?
- A. If the central bank observes a high rate of inflation, the monetary policy rule dictates an increase in the real interest rate. The high interest rate reduces output by reducing investment demand in the economy.
  - B. If the central bank observes a low rate of inflation, the monetary policy rule dictates an increase in the real interest rate. The high interest rate reduces output by reducing investment demand in the economy.

- C. If the central bank observes a high rate of inflation, the monetary policy rule dictates a decrease in the real interest rate. The low interest rate increases output by reducing investment demand in the economy.
  - D. If the central bank observes a low rate of inflation, the monetary policy rule dictates a decrease in the real interest rate. The low interest rate reduces output by reducing investment demand in the economy.
  - E. None of these answers is correct.
- 

- (15) (1 pt) According to the Fisher equation, if the nominal interest rate is 0% and there is 2% expected inflation, then the expected real interest rate is:
- A. -4%
  - B. -2%
  - C. 0%
  - D. 2%
  - E. None of the above.
- 

- (16) (1 pt) Assume that investment responds to interest rates in such a way that  $\bar{b} = 0.5$ . If  $\bar{a}$  rises by 2% and the real interest rate falls by 2%, short-run output:
- A. falls by 2 percent
  - B. rises by 1 percent
  - C. rises by 3 percent
  - D. falls by 1 percent
  - E. does not change
- 

- (17) (1 pt) If  $\bar{m} = 5$ , how much does inflation need to be above target to justify raising interest rates above the marginal product of capital by 1%?
- A. 0.1%
  - B. 0.2%
  - C. 0.25%
  - D. 2.5%
  - E. 5%
- 

- (18) (1 pt) The (AD) curve can be seen as:
- A. A combination of the (IS) curve and the Phillips curve.
  - B. A combination of the (IS) curve and the (LM) curve.
  - C. A combination of the (IS) curve and the monetary policy rule.
  - D. A combination of the demand curve for labor and the demand curve for investment.
  - E. A combination of the (AS) curve and the monetary policy rule.

- 
- (19) (1 pt) Assume that the central bank decides to raise its inflation target from 2% to 4%, and that people have adaptive expectations. What happens to inflation and why?
- A. Inflation rises because the central bank said so.
  - B. Inflation rises because the central bank is now responding less to deviations of inflation from the target inflation.
  - C. Inflation decreases because aggregate demand is too low at this level of inflation.
  - D. Inflation rises because the central bank now sets a lower interest rate for a given level of inflation.
  - E. Inflation decreases because of sticky expectations.
- 
- (20) (1 pt) What happens if there is a boom in China, which leads China to import more goods from the US?
- A. The US faces an positive aggregate demand shock.
  - B. The US faces a negative aggregate demand shock.
  - C. The (IS) curve shifts right.
  - D. The (AD) curve shifts right.
  - E. This does not change anything for the US.
- 
- (21) (1 pt) Assume that firms start increasing their prices more when they are faced with a higher demand from consumers. What happens?
- A. The (AD) curve shifts right.
  - B. The (AD) curve steepens.
  - C. The (AD) curve flattens.
  - D. The (AS) curve flattens.
  - E. The (AS) curve steepens.
- 
- (22) (1 pt) What happens in the (AS)/(AD) framework if investment starts to respond more to interest rate changes?
- A.  $\bar{m}$  increases.
  - B.  $\bar{b}$  increases.
  - C. The (AS) curve steepens.
  - D. The (AD) curve flattens.
  - E. The (AD) curve steepens.
- 
- (23) (1 pt) Assume that the central bank decides to raise its inflation target from 2% to 4%. What happens to the (AD) curve?

- A. The (AD) curve does not move.
- B. The (AD) curve steepens.
- C. The (AD) curve flattens.
- D. The (AD) curve shifts right.
- E. The (AD) curve shifts left.

- (24) (1 pt) Assume that your first salary coming out of UCLA is \$42,000, that your boss gives you a promotion every year of 2%. Assuming that the interest rate is 5%, how much would your human capital be worth if you were able to live forever?
- A. \$1,200,000.
  - B. \$1,270,000.
  - C. \$1,400,000.
  - D. \$1,470,000.
  - E. \$1,600,000.

- (25) (1 pt) Assume that your first salary coming out of UCLA is \$70,000, that your boss gives you a promotion every year of 10%. Assuming that the interest rate is 3%, how much will you earn approximately over the next 8 years, in present value?
- A. \$663,000.
  - B. \$713,000.
  - C. \$763,000.
  - D. \$813,000.
  - E. \$863,000.

## Bathtub Model

In subsequent multiple choice questions, we consider the following "bathtub" model of unemployment. There are  $\bar{L} = 161,000,000$  people in the labor force. Jobs separate at a rate  $\bar{s} = 3\%$  every year, and the annual rate at which unemployed people find new jobs is  $\bar{f} = 60\%$ . Finally, the number of people unemployed is denoted by  $U_t$  and the number of people employed as  $E_t$ . The unemployment rate is denoted by  $u_t$ , and the long run unemployment rate by  $u^*$ .

- (26) (1 pt) Which equality (equalities) is (are) true?
- A.  $U_{t+1} = \bar{f}U_t - \bar{s}E_t$ .
  - B.  $\Delta U_{t+1} = \bar{f}U_t - \bar{s}E_t$ .
  - C.  $U_{t+1} - U_t = \bar{f}U_t - \bar{s}(\bar{L} - U_t)$ .
  - D.  $U_{t+1} - U_t = \bar{f}U_t - \bar{s}E_t$ .
  - E.  $\Delta U_{t+1} = \bar{s}E_t - \bar{f}U_t$ .

- (27) (1 pt) Assume that  $u_0 = 10\%$ . What is the value of  $u^*$ ?
- A. 3.51%.
  - B. 4.22%.
  - C. 4.76%.
  - D. 5.02%.
  - E. 6.16%.
- 
- (28) (1 pt) Assume that  $u_0 = 12\%$ . What is the unemployment rate at time 1 in this economy?
- A. 4.22%.
  - B. 5.44%.
  - C. 6.22%.
  - D. 7.44%.
  - E. 8.22%.
- 
- (29) (1 pt) Assume that  $u_0 = 12\%$ . Approximately how many people are unemployed at time 2 in this economy?
- A. 8,262,000.
  - B. 8,762,000.
  - C. 9,262,000.
  - D. 9,762,000.
  - E. 10,762,000.
- 
- (30) (1 pt) How many people find a new job every year in the long run steady state?
- A. 0.
  - B. 2,300,000.
  - C. 4,600,000.
  - D. 6,900,000.
  - E. With the given elements, one cannot know for sure.
- 
- (31) (1 pt) How many people lose their job every year in the long run steady state?
- A. 0.
  - B. 2,300,000.
  - C. 4,600,000.
  - D. 6,900,000.
  - E. With the given elements, one cannot know for sure.
-



## Two-Period Consumption Model

Consider the two period consumption model solved during the class, and assume that  $\beta = \frac{1}{3}$  and utility takes the log form, that is  $u(c) = \log(c)$ . Suppose the real interest rate is 5 percent, that is  $R = 5\%$ . Assume that initial assets are  $f_0 = \$50,000$ , and the path of labor income is  $y_0 = \$100,000$  and  $y_1 = \$1,000,000$ .

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(32) (1 pt) How many different methods can be used to derive the optimality condition for the consumer?

- A. 1.
  - B. 2.
  - C. 3.
  - D. 4.
  - E. 5.
- 

(33) (1 pt) What fraction of his total wealth does the consumer consume in period 0?

- A. 0%
  - B. 25%
  - C. 50%.
  - D. 75%.
  - E. 100%.
- 

(34) (1 pt) What is the consumer's approximate human wealth?

- A. \$942,000.
  - B. \$990,000.
  - C. \$1,052,000.
  - D. \$1,102,000.
  - E. \$1,150,000.
- 

(35) (1 pt) How much does the consumer save approximately (in addition to his initial assets) in period 0?

- A. \$193,000.
  - B. \$204,000.
  - C. \$215,000.
  - D. \$226,000.
  - E. \$236,000.
- 

(36) (1 pt) How much does the consumer approximately consume in period 1?

- A. \$237,000.

- B. \$268,000.
  - C. \$289,000.
  - D. \$320,000.
  - E. \$345,000.
- 

### Government and the Macroeconomy

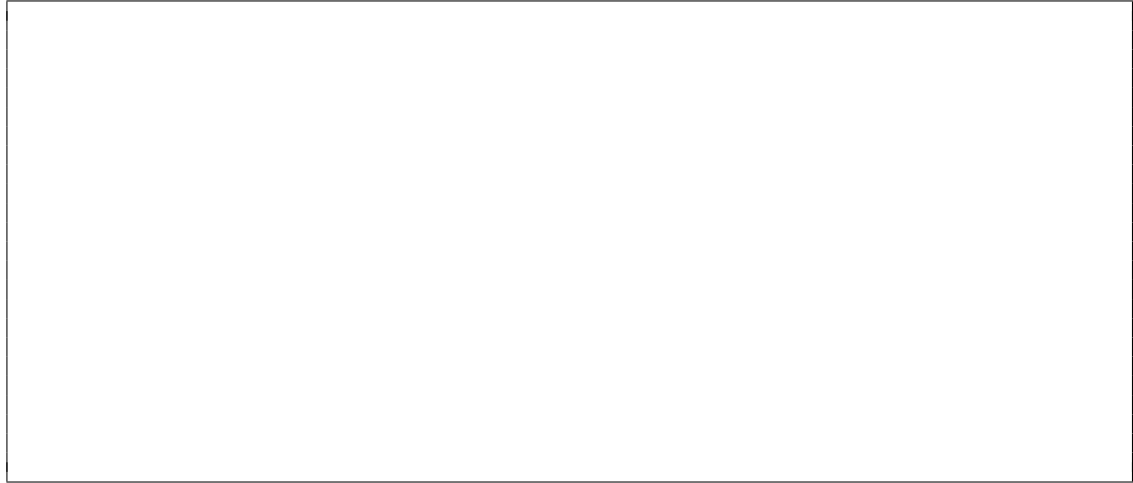
- (37) (1 pt) Which of the following statement(s) is (are) true?
- A. The real interest rate is always non negative.
  - B. Public debt cannot be higher than the level of GDP.
  - C. Government debt reduces capital accumulation.
  - D. Government debt is always a problem.
  - E. Government debt always leads to future higher taxes.
- 
- (38) (1 pt) In a two period model, the government budget constraint writes:
- A.  $T_1 + T_2 = G_1 + G_2 + B_1$ .
  - B.  $T_1 - G_1 = (1 + i)(G_2 - T_2) + B_1$ .
  - C.  $(1 + i)B_1 = (T_1 - G_1) + \frac{T_2 - G_2}{1 + i}$ .
  - D.  $T_1 - G_1 = (1 + i)(G_2 - T_2) - (1 + i)B_1$ .
  - E.  $T_1 + \frac{T_2}{1 + i} = G_1 + \frac{G_2}{1 + i} + (1 + i)B_1$ .
- 
- (39) (1 pt) Who studied the impact of government debt in an infinite horizon model?
- A. John M. Keynes.
  - B. Milton Friedman.
  - C. Peter A. Diamond.
  - D. John B. Taylor.
  - E. Ben S. Bernanke.
- 
- (40) (1 pt) In an infinite horizon model, long-run government debt:
- A. Will always equal to zero.
  - B. Can raise every generation's consumption.
  - C. May increase production.
  - D. Will increase capital accumulation.
  - E. Will decrease capital accumulation.
-

## An Oil Price Shock in the AS/AD Model (20 points)

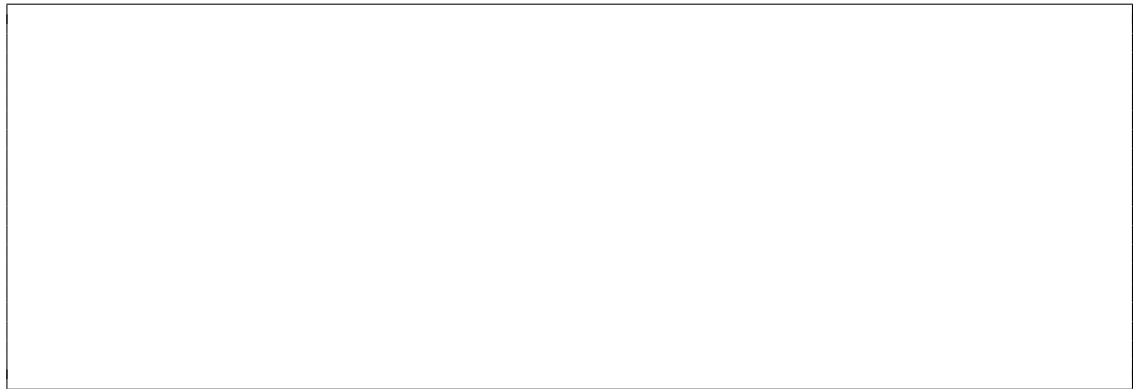
- B. (20 pts) Take the usual AS/AD model, ruling out Aggregate Demand shocks, so with  $\bar{a} = 0$ , but assuming a one-time, unexpected oil price shock  $\bar{o}_0 > 0$ . One time means that the oil price shock lasts only for one period, in period  $t = 0$ , and that  $\bar{o}_t = 0$  for all subsequent  $t \in \{1, 2, \dots\}$ . Unexpected means that the economy was originally in steady-state, and in particular that  $\pi_0 = \bar{\pi}$ . Unless otherwise noted, agents have adaptive expectations about inflation. The economy is described by an AS/AD model.
- (1) (2 pts) What are the values of  $\pi_1$  and  $\tilde{Y}_1$  in terms of the parameters of the model? (in particular the size of the oil price shock,  $\bar{o}_0$ )

- (2) (2 pts) Show in mathematical terms the effect of a more aggressive monetary policy on inflation and short-run output in period 1: do inflation and short-run output increase or decrease with a more aggressive monetary policy?

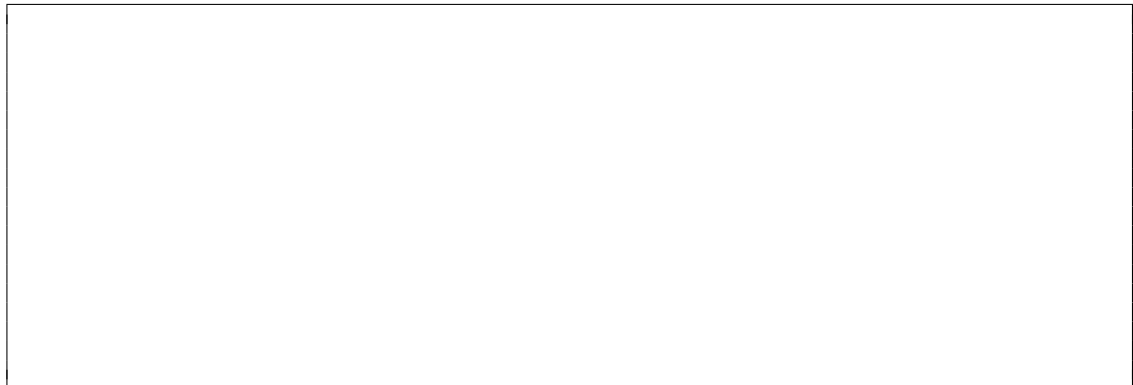
- (3) (2 pts) Illustrate this on two graphs with the AS/AD curves: show one AS/AD diagram with a soft monetary policy, and next to it another AS/AD diagram with an aggressive monetary policy. (**please indicate explicitly which is which**) Show  $\pi_1$  and  $\tilde{Y}_1$  as well as the long run values of inflation and short-run output on these graphs.

Two large, empty rectangular boxes are provided for drawing AS/AD diagrams. The first box is for a soft monetary policy, and the second is for an aggressive monetary policy. The boxes are side-by-side.

- (4) (2 pts) What are the values of  $\tilde{Y}_1$  and  $\pi_1$  when the central bank does not respond at all to changes in inflation?

A large, empty rectangular box is provided for writing the answer to question 4.

- (5) (2 pts) What are the values of  $\tilde{Y}_1$  and  $\pi_1$  when the central bank responds with a parameter  $\bar{m} = +\infty$  in the monetary policy rule?

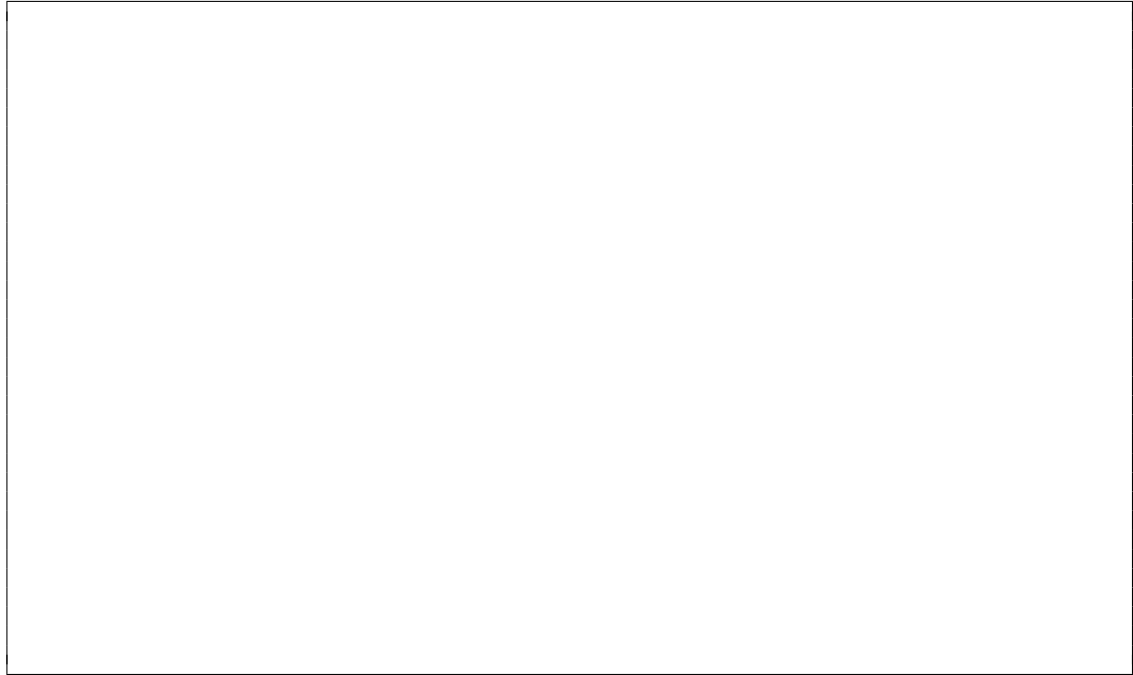
A large, empty rectangular box is provided for writing the answer to question 5.

- (6) (2 pts) What is the intuition behind the result in the previous question?

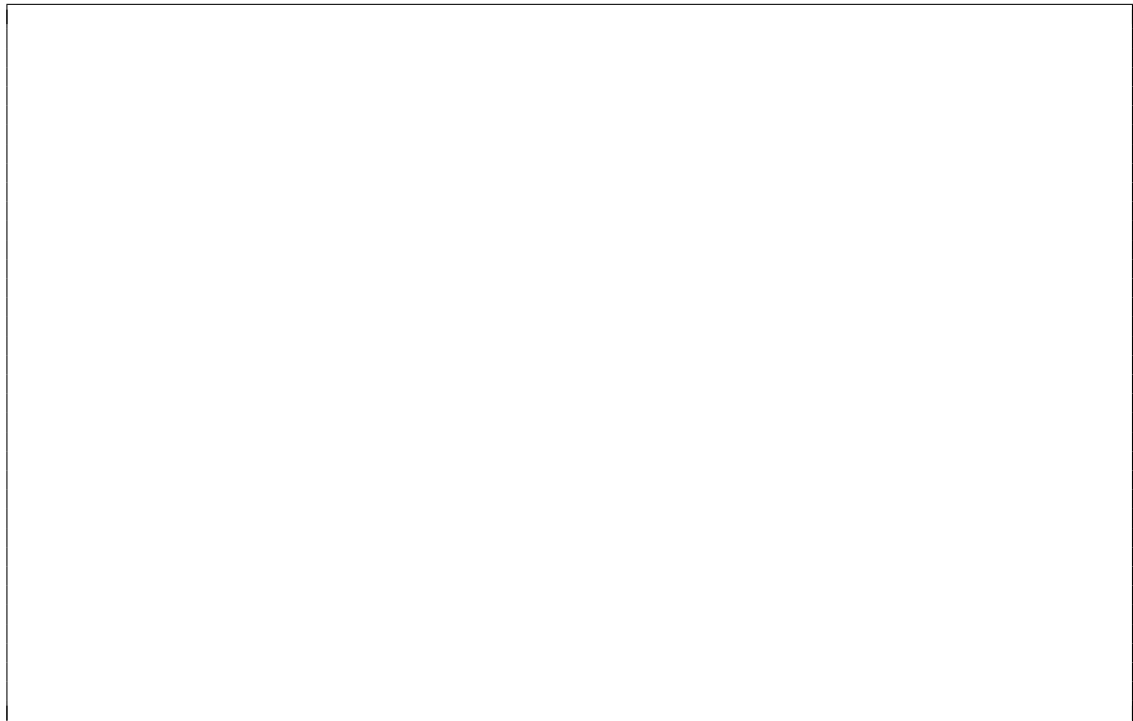
- (7) (2 pts) Find a difference equation for  $\pi_t$ , for  $t \in \{2, 3, \dots\}$ .

- (8) (2 pts) Solve for the previous difference equation, and get  $\pi_t$  as a function of time and parameters.

- (9) (2 pts) Use the (AD) curve to then calculate  $\tilde{Y}_t$  as a function of time and the parameters of the model.



- (10) (2 pts) Numerical Application: Suppose the parameters of the (AS) and (AD) curves take the following values:  $\bar{o}_0 = 8\%$ ,  $\bar{a} = 0$ ,  $\bar{b} = 2$ ,  $\bar{m} = 1$ ,  $\bar{\nu} = 1$ , and  $\bar{\pi} = 4\%$ . Solve for the value of short-run output and the inflation rate for the first 2 years after the shock. (**give an approximation**)



## Long-Run / Microfoundations: a Growth model with an endogenous saving behavior (20 points)

- C. Consider a closed economy with the following Cobb-Douglas, constant returns to scale, production function: (beware of the exponents !)

$$Y_t = \bar{A}K_t^{1/4}L_t^{3/4}.$$

Assume that the labor force is fixed to unity:  $L_t = \bar{L} = 1$ . Assume that labor is taxed at rate  $\tau$  (that is, if the employer pays  $w_t$  in wages, the worker receives only  $(1 - \tau)w_t$ ). Assume that capital depreciates at rate  $\bar{d} = 1 = 100\%$ . (that is, capital fully depreciates each period)

- (1) (2 pts) Assuming firms are competitive and maximize profits, what is the wage  $w_t$  paid by employers in period  $t$  as a function of  $\bar{A}$  and the level of the capital stock in period  $t$ ,  $K_t$  ?

- (2) (2 pts) What is the wage received by workers, as a function of  $\tau$ ,  $\bar{A}$  and the level of the capital stock in period  $t$ ,  $K_t$  ?

- (3) (2 pts) Represent the labor market (labor supply and labor demand), with employment on the  $x$  axis, and the wage  $w_t$  on the  $y$  axis. Show the effect of the imposition of a tax. Show the deadweight loss.

- (4) (2 pts) Who effectively pays the tax? What is the economic intuition for that? Taking  $K_t$  as given, what is the effect of the tax on output  $Y_t$ ?

**From now on, and until the end of this exercise, we assume that  $\tau = 0$ .** Moreover, instead of assuming that savings are a fixed fraction  $\bar{s}$  of output, we will instead derive the saving behavior from microfoundations. We assume that people in this economy live only for two periods. People from generation  $t$  are young in period  $t$ , and old in period  $t + 1$ . We denote their consumption when young by  $c_t^y$  and their consumption when old by  $c_{t+1}^o$ . Assume that lifetime utility is logarithmic with  $\beta = 1$ :

$$U = \log(c_t^y) + \log(c_{t+1}^o).$$

There is always two generations living in period  $t$ : the previous period's young, born in period  $t - 1$ , now old, consuming the return from their savings; and this period's young, newly born (in period  $t$ ). In questions 5-8, assume that people work when young, and then receive a wage given by  $w_t$ . They retire when old, and then do not work.

- (5) (2 pts) Calculate  $c_t^y$  and  $c_{t+1}^o$  as a function of  $w_t$ . (you can give the solution without an explanation) Calculate saving by the young, given by  $w_t - c_t^y$ .

- (6) (2 pts) What is the relationship between savings by the young and investment in this economy? (Hint: remember that the economy is closed !) Write the law of motion for capital as a function of the parameters of the model. Note that it takes a very similar form as that in the Solow model. What is the savings rate in this model corresponding to  $\bar{s}$  in the Solow model?



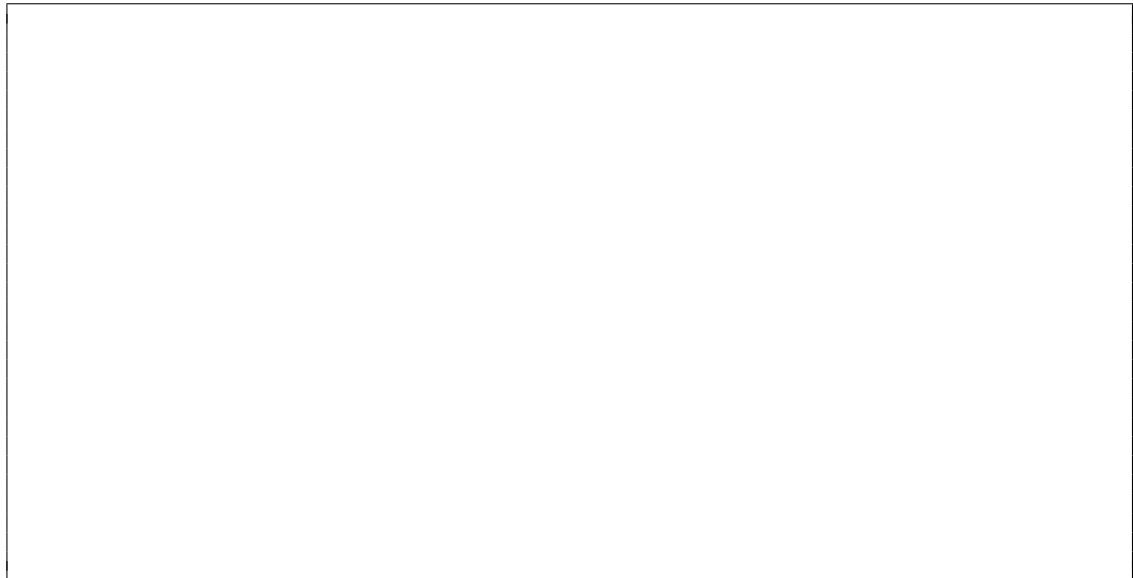
- (7) (2 pts) Assume now (in questions 7-10) that people work two thirds of the time when young, and another third when old, earning wage  $2w_t/3$  in the first period, and  $w_t/3$  in the second period. Write the arbitrage condition for the firm between the marginal product of capital, depreciation, and the interest rate  $R$ , assuming that the price of capital is constant and equal to one.

- (8) (2 pts) What is an expression for  $R$  as a function of  $K_t$  and the parameters of the model?

- (9) (2 pts) Write the law of motion for capital ONLY as a function of the parameters of the model. (in particular, substitute out  $R$ )



- (10) (2 pts) Why does it differ strikingly from the Solow model?



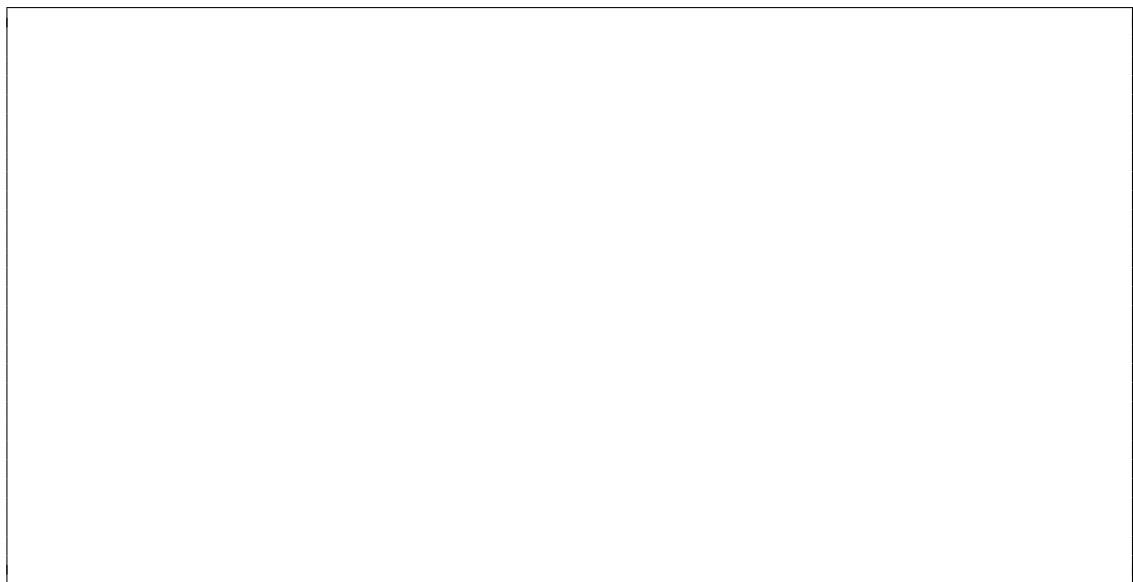
## Long-Run / Solow-Romer Model (20 points)

D. Consider the following Solow model. Output  $Y_t$  is produced using capital  $K_t$  and labor  $L_t$  according to the production function:  $Y_t = \bar{A}K_t^{1/4}L_t^{3/4}$ . (note the exponents !) The amount of labor is fixed  $L_t = \bar{L}$ , and a fraction of  $\bar{s}$  of output is saved by agents in this economy. Capital depreciates every period at a rate  $\bar{d}$ .

- (1) (2 pts) Write the law of motion for capital. Solve for the steady state value of capital  $K^*$ , and the steady state value of  $Y^*$ , in this economy.



- (2) (2 pts) Show graphically that the Solow growth model converges to a steady-state. Use words to explain your graph.



- (3) (2 pts) Comment the dependence of  $Y^*$  with  $\bar{A}$ . Compare with the production model. Why is there a difference?

- (4) (2 pts) Imagine that the government can enact policies aimed at targeting people's savings rate  $\bar{s}$ . Which savings rate would maximize steady-state production? What would steady-state consumption then be equal to?

- (5) (2 pts) Using that the steady state value for consumption is equal to  $C^* = (1-\bar{s})Y^*$ , show that the savings rate  $\bar{s}$  has two opposing effects on consumption. Give an intuition.

- (6) (2 pts) Adam Smith once wrote: "Consumption is the sole end and purpose of all production". Calculate the steady-state consumption maximizing level of the savings rate  $\bar{s}$  in the Solow model.

- (7) (2 pts) Assume that  $K_0 = 2$ ,  $\bar{A} = 2$ ,  $\bar{d} = 9\%$ ,  $\bar{s}$  is the steady state consumption maximizing level of the savings rate, and  $\bar{L} = 1$ . Calculate  $K_t$  for  $t = 1, 2, 3, 4$ .

- (8) (2 pts) Consider now a Solow-Romer model where productivity grows because researchers engage in production. Assume that the efficiency of research is  $\bar{z} = 2$ , that the fraction of researchers in R&D is  $\bar{l} = 3\%$ , and that population is still given by  $\bar{L} = 1$ , and that  $A_0 = 2$ . What is  $A_t$  as a function only of  $t$ ?

- (9) (2 pts) As in question (6), calculate  $K_t$  for  $t = 1, 2, 3, 4$  when productivity is growing as above.

- (10) (2 pts) What is the rate of growth of output in the long run, as a function of  $\bar{z}$ ,  $\bar{l}$  and  $\bar{L}$ , on a balanced growth path? What is a numerical value for the growth rate of output in the long run, with the given values for  $\bar{z}$ ,  $\bar{l}$  and  $\bar{L}$  above? Give an intuition for why the growth rate of output and the growth rate of productivity are different.

## Scratch Paper

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