Econ 002- INTRO MACRO Prof. Luca Bossi November 11, 2010
MIDTERM #2 SUGGESTED SOLUTIONS

YOUR NAME: ______________________________________
YOUR PENN STUDENT NUMBER: ________________________
YOUR R.I.’s NAME: _____________________________________

INSTRUCTIONS

The exam is closed book. It is composed of 20 multiple choice questions and two exercises. All multiple choice questions are worth 3 points (so the total is 60 for the multiple choice part). The exercises are worth 20 points each (so the total is 40 for the exercise part).

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

Provide your answers on the exam sheet directly.

Only the first five pages of the exam will be graded.

Read all questions very carefully. Write legibly.

EXAM TAKING POLICY

If you need to use the restroom, or you need a pencil or scratch paper, or some other supply that we might have, 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.

NO CELL PHONES. NO IPODS OR SIMILAR DEVICES WITH CALCULATOR “APPS”. YOU CANNOT CONNECT TO THE INTERNET. USE A UPENN APPROVED CALCULATOR. NO BOOKS. NO NOTES. NO HELP SHEETS. NO TALKING TO EACH OTHER. NO ASKING THE PROCTORS ANY QUESTIONS ABOUT THE EXAM. 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 EVERY SINGLE PAGE OF THE EXAM PLEASE RETURN THE EXAM SPECIFICALLY TO YOUR R.I. WHEN YOU ARE DONE PLEASE DO NOT START THIS EXAM UNTIL INSTRUCTED TO DO SO.

GOOD LUCK!
EXERCISE I

The market for loanable funds is characterized by the following set of equations:

\[ Q = 0.5a^r \]
\[ Q = -0.5r + 0.5 \]

a) (5 points) Calculate the equilibrium when \( a = 1 \). Show your work.

\[ 0.5r = -0.5r + 0.5 \]
\[ r = 0.5 \]
\[ Q = 0.25 \]

b) (5 points) Imagine that you are the government and that you want the equilibrium interest rate to be 4\%. Let \( a = 1 \) again. Pick the per quantity subsidy/tax to saving that leads to that equilibrium. Show your work.

If \( r = 0.04 \) then from the demand we know that in equilibrium it must be \( Q = -0.5*0.04 + 0.5 = 0.48 \).

If \( a = 1 \), you want to find a per quantity subsidy/tax \( x \) to saving such that:

\[ 0.48 = 0.5*1*0.04 + x \]
\[ x = 0.46 \]

c) (5 points) Come back to part a) of the exercise. Imagine that the desired equilibrium the government wants to achieve is \( r = 8\% \), but the authority wants now to change the parameter \( a \) to obtain that. By what percentage \( a \) must change with respect to \( a = 1 \)? Show your work.

If \( r = 0.08 \) then from the demand we know that in equilibrium it must be \( Q = -0.5*0.08 + 0.5 = 0.46 \).

You want to find \( a \) in the supply such that:

\[ 0.46 = 0.5*a*0.08 \]
\[ a = 11.5 \]

Which means that \( a \) must increase \( a \) by \( 100*(11.5 - 1) = 1,050\% \) compared to \( a = 1 \).

d) (5 points) Find the total welfare (total surplus) you obtain in your answer for part b) using the demand and supply of part b). Find the total welfare (total surplus) you obtain in your answer for part c) using the demand and supply of part c). What policy yields a higher welfare? Neglect the fact that government intervention causes a distortion, I just want you to compare total welfare in part b) with total welfare in part c). Show your work using a graph.

Total welfare is the area between demand and supply up to the equilibrium price (triangle area labeled “Welf” in the graph below).
Look at the demand function for a second. When $Q = 0$ in the demand function, we have that $r = 1$ that is precisely the intercept in the graph above for the demand function. The supply function passes through the origin in part c).

For part b) the supply it is shifted down. By how much? Well 0.46 is the value of $x$ the subsidy you found in part b) to the supply. The supply is $Q = 0.5a*r = 0.5*r \Rightarrow r = 2*Q \Rightarrow$ shift down is $2*0.46 = 0.92$

That is the shift down to the right

The base of the “welfare triangle” is thus 1 for answer c) and $1+0.92 = 1.92$ for answer b). The height of the triangle instead depends on the specific equilibrium value of $Q$ for each answer. In part b) the equilibrium value we saw it was $Q = 0.48 \Rightarrow$ height of the triangle for part b) Hence the area of the triangle for part b) is $0.5*1.92*0.48 = 0.46$ in this case.

In part c) the equilibrium value was $Q = 0.46 \Rightarrow$ height of the triangle for part c) Hence the area of the triangle is $0.5*1*0.46 = 0.23$ in this case.

The policy in part b) gives a higher welfare $0.46 > 0.23$
EXERCISE II
Consider the Solow model we have seen and studied in class.
Assume that the production function is given by the Cobb-Douglas expression
\[ Y_t = AK_t^a L_t^{1-a} \]

a) (5 points) Write down the 5 basic equations that characterize the Solow model. Show your work.

Now recall that the fundamental equation of the Solow model is:

\[ k_{t+1}(1+n) = sy_t + (1-d)k_t \]

Where:
- \( k_{t+1} \) = future physical capital per person
- \( n \) = population growth rate
- \( s \) = saving rate
- \( y_t \) = output per person
- \( d \) = depreciation rate of capital
- \( k_t \) = current physical capital per person

A criticism that the Solow model is subject to is that the whole population works and that all the workers are the same. Suppose now we want to tweak that. In particular, we want to have a situation where workers can exert different work efforts. We model this by assuming that in the production function \( A = 1 \) when workers exert regular work effort, whereas \( A > 1 \) when workers exert high work effort.

b) (5 points) Find the expression for the steady state level of physical capital per person when all workers exert high work effort and the expression for the steady state level of physical capital per person when all workers exert regular work effort. (Hint: you need to find the expression of output per person first, and then use the equation given above). Show your work.

c) (5 points) Find the expression for the steady state level of output per person when all workers exert high work effort and the expression for the steady state level of output per person when all workers exert regular work effort. Show your work.

d) (5 points) Compute the percentage change of the steady state level of output per person between an economy with all workers exerting high work effort and an economy with all workers exerting regular work effort. Compare what you obtained to the percentage change of the steady state level of capital per person between an economy with all workers exerting high work effort and an economy with all workers exerting regular work effort. Which growth rate is larger among those two? Show your work.
Solution:

a) The five equations are

1) \( Y_t = A K_t^\alpha L_t^{1-\alpha} \)
2) \( S_t = s Y_t \)
3) \( I_t = S_t \)
4) \( K_{t+1} = K_t + (1 - d) K_t \)
5) \( L_{t+1} = (1 + n) L_t \)

b) Output per person is:

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

With the small caps convention the expression above becomes:

\( y_t = A(k_t)^\alpha \)

Using this into the fundamental equation that was given to you:

\( k_{t+1}(1 + n) = sA(k_t)^\alpha + (1 - d)k_t \)

In steady state we know that:

\( k_{t+1} = k_t = \bar{k} \)

Plug this into the fundamental equation to obtain:

\( 0 = sA(\bar{k})^\alpha - (n + d)\bar{k} \)

Solving for \( \bar{k} \):

\[
\bar{k} = \left( \frac{n + d}{sA} \right)^{\frac{1}{\alpha-1}} = \left( \frac{sA}{n + d} \right)^{\frac{1}{1-\alpha}} = A^{\frac{1}{1-\alpha}} \left( \frac{s}{n + d} \right)^{\frac{1}{1-\alpha}}
\]

This is the steady state level of physical capital per person when all workers exert high work effort. Let’s re-label for convenience this expression \( \bar{k}_{HI} \).

When all workers exert low work effort simply plug \( A=1 \) into the expression above.

\[
\bar{k} = \left( \frac{s}{n + d} \right)^{\frac{1}{1-\alpha}}
\]
Let’s re-label for convenience this expression $k_{LO}$

e) To find the steady state of output per capita, we must simply plug $k_{LO}$ and $k_{HI}$ in the per capita production function $y_t = A(k_t)^{\alpha}$ and find:

$$y_{HI} = AA^{\frac{\alpha}{1-\alpha}} \left( \frac{s}{n+d} \right)^{\frac{1}{1-\alpha}} = A^{\frac{1}{1-\alpha}} \left( \frac{s}{n+d} \right)^{\frac{1}{1-\alpha}}$$

When all workers exert low work effort simply plug $A=1$ into the expression above.

$$y_{LO} = \left( \frac{s}{n+d} \right)^{\frac{1}{1-\alpha}}$$

d) Before starting to compute anything you can notice that the expression $\left( \frac{s}{n+d} \right)^{\frac{1}{1-\alpha}}$ is present in both $k_{LO}$ and $k_{HI}$ hence it will not affect the growth rate as we can factor it out and simplify.

$$100 \times \frac{k_{HI} - k_{LO}}{k_{LO}} = 100 \times (A^{\frac{1}{1-\alpha}} - 1)$$

Analogously you can notice that the expression $\left( \frac{s}{n+d} \right)^{\frac{1}{1-\alpha}}$ is present in both $y_{HI}$ and $y_{LO}$ Hence it will not affect the growth rate as we can factor it out and simplify.

$$100 \times \frac{y_{HI} - y_{LO}}{y_{LO}} = 100 \times (A^{\frac{1}{1-\alpha}} - 1)$$

The growth rates are exactly the same.

**MULTIPLE CHOICE QUESTIONS**

1) The president of a poor country has announced that he will implement the following measures which he claims are designed to increase growth: 1. Reduce corruption in the legal system; 2. Reduce reliance on market forces because they allocate goods and services in an unfair manner; 3. Restrict investment in domestic industries by foreigners because they take some of the profits out of the country; 4. Encourage trade with neighboring countries; and 5. Increase the fraction of GDP devoted to consumption. How many of these measures will have a positive effect on growth?

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<tr>
<th>Option</th>
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<tr>
<td>a.</td>
<td>1</td>
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<td>b.</td>
<td>2</td>
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<td>c.</td>
<td>3</td>
</tr>
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<td>d.</td>
<td>4</td>
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2) The dictator of Turan has recently begun to arbitrarily seize farms belonging to his political opponents, and he has given the farms to his friends. His friends don't know much about farming. The courts in Turan have ruled that the seizures are illegal, but the dictator has ignored the rulings. Other things equal, we would expect that the growth rate in Turan will

<table>
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<th>Option</th>
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<tr>
<td>a.</td>
<td>fall temporarily, but will return to where it was when the new owners learn how to farm.</td>
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b. increase because the total amount of human capital in the country will increase as the new owners learn how to farm.

c. fall and remain lower for a long time.

d. not be affected unless widespread civil disorder or civil war results.

3) Assume the Indian real GDP per capita is 12.5% of the real GDP per capita in the US. If Indian per capita GDP grows at 7% and US per capita GDP grows at 2% how many years will it take for India to catch up with the US?

a. Approximately 42 years
b. Approximately 46 years.
c. Approximately 37 years
d. Approximately 33 years

We know that today GDP India = 0.125 GDP US

We need to compute T for the following equation

GDP India*(1.07)^T=GDP US*(1.02)^T

So

0.125 GDP US *(1.07)^T=GDP US*(1.02)^T simplifying
0.125*(1.07)^T=(1.02)^T

Solving for T

\[ \ln(0.125)+T\ln(1.07)=T\ln(1.02) \]

T is approx 42.

4) On a production function, as capital per worker increases, output per worker

a. increases. This increase is larger at larger values of capital per worker.
b. increases. This increase is smaller at larger values of capital per worker.
c. decreases. This decrease is larger at larger value of capital per worker.
d. decreases. This decrease is smaller at larger value of capital per worker.

5) Suppose a country imposes new restrictions on how many hours people can work. 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.

6) Which of the following are effects of an increased budget deficit?

a. the supply of loanable funds does not change; a higher interest rate reduces private saving
b. the supply of loanable funds does not change; a higher interest rate raises private saving
c. at any interest rate the supply of loanable funds is less; a higher interest rate reduces private saving
d. at any interest rate the supply of loanable funds is less; a higher interest rate raises private saving

7) Which of the following is included in the demand for loanable funds?

a. investment and government borrowing
b. investment but not government borrowing
c. government borrowing but not investment
d. neither government borrowing nor investment
8) Which of the following events could explain a decrease in interest rates together with an increase in investment?

a. The government went from surplus to deficit.
b. The government instituted an investment tax credit.
c. The government reduced the tax rate on savings.
d. None of the above is correct.

9) Suppose the government deficit increases, but the interest rate remains the same. Which of the following things might have happened simultaneously to keep interest rates the same?

a. The government reduces the amount that people may put into savings accounts on which the interest is tax exempt.
b. Because they are optimistic about the future of the economy, firms desire to borrow more to purchase physical capital.
c. Consumers decide to decrease consumption and work more.
d. All of the above could explain why the interest rate would be unchanged.

10) Suppose a government that taxed all interest income changed its tax law so that the first $5,000 of a taxpayer’s interest income was tax free. This would shift the

a. supply of loanable funds to the right, causing interest rates to fall.
b. supply of loanable funds to the left, causing interest rates to rise.
c. demand for loanable funds to the right, causing interest rates to rise.
d. demand for loanable funds to the left, causing interest rates to fall.

11) You have some estimates of national accounts numbers for a closed economy for the coming year. Under one set of expectations, government purchases will be $30 billion, transfer payments will be $10 billion, and taxes will be $45 billion. Under another set of expectations, GDP will be $200 billion, taxes will be $50 billion, transfer payments will be $20 billion, consumption will be $120 billion, and investment will be $40 billion. Based on these numbers in the first case there should be a

a. $15 billion surplus, and in the second case a $10 billion surplus.
b. $15 billion surplus, and in the second case a $10 billion deficit.
c. $5 billion surplus, and in the second case a $10 billion surplus.
d. $5 billion surplus, and in the second case a $10 billion deficit.

The key here is to remember that to compute the budget deficit/surplus taxes are NET of transfer payments.

12) The bond market

a. is a financial market, whereas the stock market is a financial intermediary.
b. is a financial intermediary, whereas the stock market is a financial market.
c. is a financial market, as is the stock market.
d. is a financial intermediary, as is the stock market.

13) Al claims that $200 collecting 4 percent interest for 2 years has the same future value as $200 collecting 8 percent interest for 1 year. Bill says that waiting one year for $200 when the interest rate is 8 percent has the same present value as waiting 2 years for $200 when the interest rate is 4 percent. (Do this exercise considering two decimal points)

a. Both Al and Bill are correct.
b. Both Al and Bill are incorrect.
c. Only Al is correct.
d. Only Bill is correct.

We need to evaluate both statements using the Present Discounted Value formula $FV = PV(1+r)^T$: 
Al statement
FV = 200(1.04)^2 = 216.32
200(1.08)^1 = 216
So Al is wrong.
Bill statement
PV=200/(1.08)^1=185.18
PV=200/(1.04)^2=184.91
So Bill is wrong.

14) If a person is risk averse, then as wealth increases, total utility of wealth
a. increases at an increasing rate.
b. increases at a decreasing rate.
c. decreases at an increasing rate.
d. decreases at a decreasing rate.

15) Consider the following production function:
\[ Y = \frac{2KL}{K + L} \]
Is it Constant Return to Scale?
a. Yes, always
b. No, it is increasing return to scale
c. No, it is decreasing return to scale
d. Both a and b are correct.
Step 1: multiply each factor of production by a constant, say x which is different from 0 or 1,
\[ \frac{2(xK)(xL)}{xK + xL} = x \frac{2KL}{K + L} \]
Step 2: manipulate mathematically the above expression so that you can factor out x somehow.
\[ x \frac{2KL}{x(K + L)} = 2xKL \]
Step 3: use the production function (i.e. the definition of Y) to find the answer. We want to check whether
after multiplying each factor of production by x, Y is multiplied by the same amount x too or not.
In our specific case \[ Y = \frac{2KL}{K + L} \] so we obtained that multiplying each factor of production by x yields
(from step 2): \[ x \frac{2KL}{K + L} \] this expression is equal to \[ xY \] always.

16) Money
a. is a perfect store of value.
b. is the most liquid asset.
c. has intrinsic value, regardless of which form it takes.
d. All of the above are correct.

17) If the Federal Open Market Committee decides to increase the money supply, then the Federal Reserve
a. creates dollars and uses them to purchase government bonds from the public.
b. sells government bonds from its portfolio to the public.
c. creates dollars and uses them to purchase various types of stocks and bonds from the public.
d. sells various types of stocks and bonds from its portfolio to the public.
18) In a system of 100-percent-reserve banking,
   a. banks do not accept deposits.
   b. loans are the only asset item for banks.
   c. banks do not influence the supply of money.
   d. All of the above are correct.

19) A problem that the Fed faces when it attempts to control the money supply is that
   a. federal legislation in the 1950s stripped the Fed of its power to act as a lender of last resort to banks.
   b. the Fed has to get the approval of the U.S. Treasury Department whenever it uses any of its monetary policy tools.
   c. while the Fed has the ability to change the money supply by a large amount, it does not have the ability to change it by a small amount.
   d. since the U.S. has a fractional-reserve banking system, the amount of money in the economy depends in part on the behavior of depositors and bankers.

20) When a bank loans out $1,000, the money supply
   a. does not change.
   b. decreases.
   c. increases.
   d. may do any of the above.