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Nova School of Business and Economics
Macroeconomics, 1103 - 1st Semester 2012-2013
Prof. André C. Silva
TA: João Morgado

Final

Maximum points: 20. Time: 2h. Pages: 12. The exam is closed books, closed notes. No calculators are allowed. Answer the questions in the space provided.

1. (2 pts) On the webpages of central banks, the objective of price stability is usually put with emphasis. On the other hand, maintaining high economic growth or high employment are usually shown with less emphasis. Why would central banks put so much emphasis on the objective of price stability? Explain.

2. (2 pts) Circle the correct answer.

a. According to the one-period model seen in class, an increase in government expenditures implies (a decrease / no change / an increase) in wages and (a decrease / no change / an increase) in real output.

b. GDP per capita in Portugal as a ratio of GDP per capita in the United States has (decreased / been approximately constant / increased) since 1950 according to the data in the Penn World Table.

c. In order to fight unemployment, the government introduces a subsidy on employment. The implementation of the subsidy is the following: every firm that hires N hours of labor receives sN euros. With this measure, employment will likely (decrease / not change / increase) and welfare will likely (decrease / not change / increase).

d. To finance an increase in government consumption, the government considers an increase in current taxes or an additional issue of government bonds. If the taxes are lump sum, an additional issue of government bonds will imply (smaller / no change in / higher) output as compared to an increase in taxes.

3. (4 pts) An economy experiences an increase in investment and an increase in interest rates at the same time. How can this behavior be explained? Justify. Use a graph for savings and investment in your answer.

(Additional Space)

4. (6 pts) An economy receives a persistent and positive shock on total factor productivity. Following the notation used in class, z and z' increase, where the increase in z is larger than the increase in z' . Prices are flexible so that markets are in equilibrium in all periods. The central bank maintains a constant supply of money.
- a. (4 pts) Obtain the predicted changes on wages, interest rates, employment, output, and prices after the shock. Use the diagrams $w \times N$, $r \times Y$, and $P \times M$. Justify.

(Additional Space)

b. (2 pts) Consider the predictions on consumption, the price level, employment, and wages. Do the predictions on a variable being procyclical or countercyclical agree with the data? Explain.

5. (6 pts) The consumers in country A have preferences

$$\log c_1 + \beta \log c_2, \tag{1}$$

where c_1 and c_2 refer to consumption at periods 1 and 2, and $0 < \beta < 1$. \log is the logarithm to the base e . The consumers may borrow and lend at the real interest rate r . Let savings be denoted by s . Given real output y_1 and y_2 , aggregate consumption and savings satisfy the budget constraints

$$c_1 + s = y_1, \tag{2}$$

for the first period, and

$$c_2 = y_2 + (1 + r) s, \tag{3}$$

for the second period. Optimal consumption and savings is then found by maximizing (1) subject to (2) and (3).

a. (2 pts) The economy is initially closed. Obtain the equilibrium interest rate as a function of β and output growth, $\frac{y_2}{y_1}$.

(Additional Space)

Consider the diagram $c_2 \times c_1$ (c_2 in the vertical axis) and the diagram $r \times Y$ for the goods market in period 1 (r in the vertical axis). Output growth is predicted to be small for the country A. To simplify, let $y_1 = y_2$.

b. (2 pt) Draw the diagrams $c_2 \times c_1$ and $r \times Y$ for this economy. Show how to obtain the equilibrium interest rate with the diagrams.

Country A opens up for trade with countries in another region called region B. The countries are small, but region B as whole has GDP at date 1 of about the same size of GDP in country A. On the other hand, GDP growth in region B is higher than GDP growth in country A. Think about numbers such as $y_1^B = y_1$ and $y_2^B = 2y_1$, where y_1^B, y_2^B denote output in region B at periods 1 and 2.

c. (2 pts) How will the graph $r \times Y$ change with international trade between country A and the countries in region B? What will happen with the equilibrium interest rate? (Show in the graph; it is not necessary to calculate the new equilibrium interest rate.) Will country A export or import? What will happen with welfare in country A? Explain.

(Additional Space)

SOLUTION SKETCH

1.

1. (2 pts) On the webpages of central banks, the objective of price stability is usually put with emphasis. On the other hand, maintaining high economic growth or high employment are usually shown with less emphasis. Why would central banks put so much emphasis on the objective of price stability? Explain.

Answer

There are two important points to mention to answer this question:

(1) It has been observed that long-run inflation correlates strongly with money supply growth. As central banks control the quantity of money, directly and indirectly via interest rates, the control of inflation is made by the central banks. Therefore, it is the responsibility of central banks to maintain the stability of prices.

(2) It has also been observed that fluctuations in the quantity of money affect real output and employment in the short run. However, the repeated use of changes in the quantity of money to affect output has shown to imply high rates of inflation with no further impact on output. Putting less emphasis on using short-run influence on output helps to show the commitment of central banks to maintain inflation low.

2.

2. (2 pts) Circle the correct answer.

a. According to the one-period model seen in class, an increase in government expenditures implies a decrease in wages and an increase in real output.

b. GDP per capita in Portugal as a ratio of GDP per capita in the United States has increased since 1950 according to the data in the Penn World Table.

c. In order to fight unemployment, the government introduces a subsidy on employment. The implementation of the subsidy is the following: every firm that hires N hours of labor receives sN euros. With this measure, employment will likely increase and welfare will likely decrease.

d. To finance an increase in government consumption, the government considers an increase in current taxes or an additional issue of government bonds. If the taxes are lump sum, an additional issue of government bonds will imply (smaller / no change in / higher) output as compared to an increase in taxes.

3.

3. (4 pts) An economy experiences an increase in investment and an increase in interest rates at the same time. How can this behavior be explained? Justify. Use a graph for savings and investment in your answer.

Answer

An increase in investment together with an increase in interest rates can be explained by the arrival of information that lead agents to expect higher productivity in the future. With this, firms will tend to invest more for the same interest rate as capital will be more productive in the future. The investment demand curve will shift to the right in the diagram $r \times I$. For a given supply of savings, the interest rate will increase. See figure 1.

This is one of the most likely and plausible changes that can explain an simultaneous increase in r and in I . However, other answers are possible.

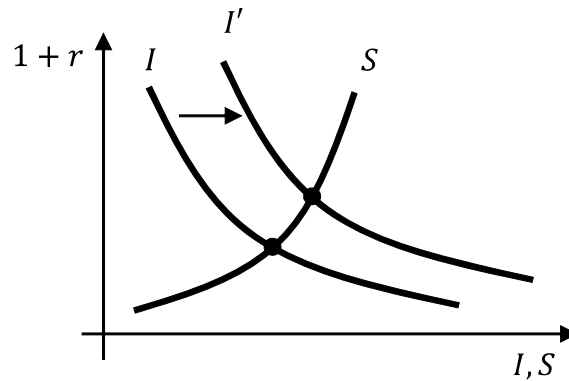


FIG. 1.

4.

4. (6 pts) An economy receives a persistent and positive shock on total factor productivity. Following the notation used in class, z and z' increase, where the increase in z is larger than the increase in z' . Prices are flexible so that markets are in equilibrium in all periods. The central bank maintains a constant supply of money.

a. (4 pts) Obtain the predicted changes on wages, interest rates, employment, output, and prices after the shock. Use the diagrams $w \times N$, $r \times Y$, and $P \times M$. Justify.

Answer

The explanation for this change can be seen in detail in the book, chapter 12, p. 441-445. The graphs for the labor market and for the goods market are in figure 2. The graph for the money market is in figure 3. These graphs are in figure 12.2 in the book.

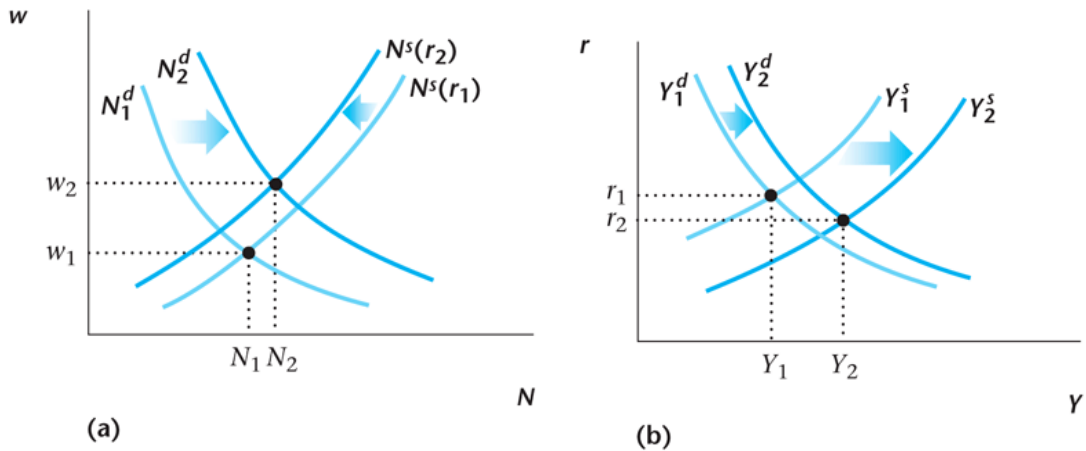


FIG. 2.

b. (2 pts) Consider the predictions on consumption, the price level, employment, and wages. Do the predictions on a variable being procyclical or countercyclical agree with the data? Explain.

Answer

According to the conclusions in item *a*, consumption increases, the price level decreases, and employment and wages increase. So, consumption, employment and wages are predicted to be procyclical while the price level is predicted to be countercyclical. These predictions are in accordance with the data for the behavior of these variables.

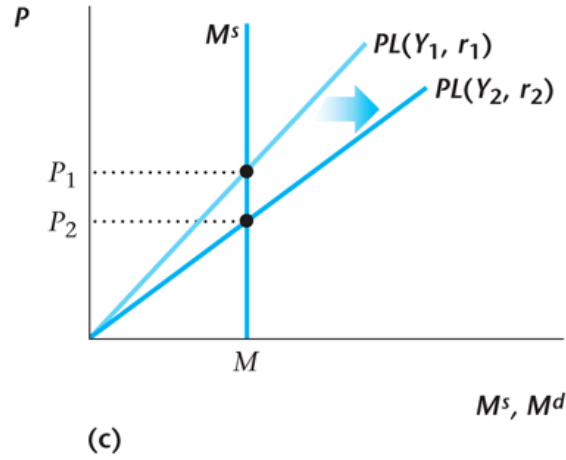


FIG. 3.

5.

5. (6 pts) The consumers in country A have preferences

$$\log c_1 + \beta \log c_2, \quad (1)$$

where c_1 and c_2 refer to consumption at periods 1 and 2, and $0 < \beta < 1$. \log is the logarithm to the base e . The consumers may borrow and lend at the real interest rate r . Let savings be denoted by s . Given real output y_1 and y_2 , aggregate consumption and savings satisfy the budget constraints

$$c_1 + s = y_1, \quad (2)$$

for the first period, and

$$c_2 = y_2 + (1 + r)s, \quad (3)$$

for the second period. Optimal consumption and savings is then found by maximizing (1) subject to (2) and (3).

a. (2 pts) The economy is initially closed. Obtain the equilibrium interest rate as a function of β and output growth, $\frac{y_2}{y_1}$.

Answer

To simplify the problem, substitute savings from (3) in (2) to obtain the present

value budget constraint

$$c_1 + \frac{1}{1+r}c_2 = y_1 + \frac{1}{1+r}y_2.$$

We can then write the problem with only one budget constraint,

$$\max \log c_1 + \beta \log c_2$$

s.t.

$$c_1 + \frac{1}{1+r}c_2 = y_1 + \frac{1}{1+r}y_2.$$

We have seen that the solution of this problem is such that optimal consumption at period 1 is given by

$$c_1 = \frac{1}{1+\beta} \left(y_1 + \frac{1}{1+r}y_2 \right).$$

Savings are given by $s = y_1 - c_1$. Therefore, we obtain

$$s = \frac{1}{1+\beta} \left(\beta y_1 - \frac{1}{1+r}y_2 \right).$$

As the economy is closed so far, aggregate savings must be equal to zero. Markets will behave so that $s = 0$. The equilibrium interest rate is the value of r such that $s = 0$. We have

$$\begin{aligned} s = 0 &\Leftrightarrow \frac{1}{1+\beta} \left(\beta y_1 - \frac{1}{1+r^*}y_2 \right) = 0 \\ &\Leftrightarrow 1 + r^* = \frac{1}{\beta} \frac{y_2}{y_1}. \end{aligned}$$

Stating that $s = 0$ is equivalent to say that production must be equal to consumption, $c_1 = y_1$. So, another way of obtaining the equilibrium interest rate is to find r^* such that $c_1(r^*) = y_1$. The result is the same as above.

Consider the diagram $c_2 \times c_1$ (c_2 in the vertical axis) and the diagram $r \times Y$ for the goods market in period 1 (r in the vertical axis). Output growth is predicted to be small for the country A. To simplify, let $y_1 = y_2$.

b. (2 pt) Draw the diagrams $c_2 \times c_1$ and $r \times Y$ for this economy. Show how to obtain the equilibrium interest rate with the diagrams.

Answer

As we saw in class, the diagram $c_2 \times c_1$ shows the budget constraint of the consumer, the optimal decision of the consumer, and the indifference curve relative to the optimal

decision. The budget constraint $c_1 + \frac{1}{1+r}c_2 = y_1 + \frac{1}{1+r}y_2$ implies

$$c_2 = -(1+r)c_1 + (1+r)\left(y_1 + \frac{1}{1+r}y_2\right).$$

So, the budget constraint is a straight line with slope $-(1+r)$. When $c_1 = 0$, the consumer only consumes at period 2 the entire saved income $(1+r)\left(y_1 + \frac{1}{1+r}y_2\right) = (1+r)y_1 + y_2$. The equilibrium interest rate will be such that $c_1 = y_1$. So, given the interest rate, the consumer will neither be a lender nor a borrower. The diagram is in figure 4.

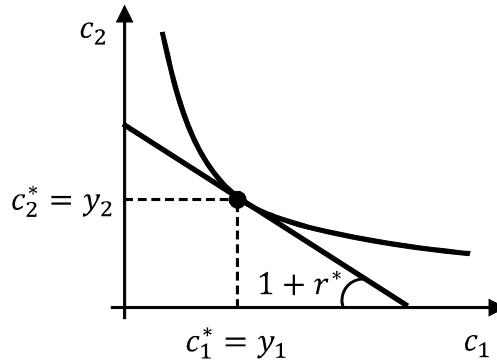


FIG. 4.

The diagram of the goods market, $r \times Y$, shows the supply and demand for goods of this economy; it is in figure 5. The demand for goods is given only by consumption, $Y^d = C(r) = c_1(r)$, with $c_1(r)$ given above. The supply of goods is given by $Y^s = y_1$. As the quantity of goods in period 1 is fixed, the supply curve is given by a straight line. The equilibrium interest rate is such that $c_1(r) = y_1$, that is, such that the supply and demand intersect.

Country A opens up for trade with countries in another region called region B. The countries are small, but region B as whole has GDP at date 1 of about the same size of GDP in country A. On the other hand, GDP growth in region B is higher than GDP growth in country A. Think about numbers such as $y_1^B = y_1$ and $y_2^B = 2y_1$, where y_1^B, y_2^B denote output in region B at periods 1 and 2.

c. (2 pts) How will the graph $r \times Y$ change with international trade between country A and the countries in region B? What will happen with the equilibrium interest rate? (Show in the graph; it is not necessary to calculate the new equilibrium

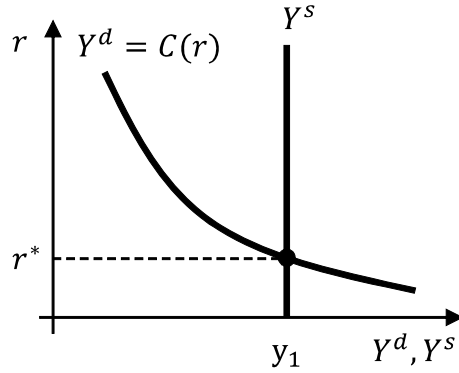


FIG. 5.

interest rate.) Will country A export or import? What will happen with welfare in country A? Explain.

Answer

As the other countries in region have higher output growth and region B has a significant size, the equilibrium interest will increase. This new interest will prevail across all countries now engaged in international trade.

As the interest rate increases from the situation in item *b*, the budget constraint will rotate clockwise as shown in figure 6. The new equilibrium interest rate, for the open economy, is represented by r^O . The former equilibrium interest rate, for the closed economy, is represented by r^C . We have $r^O > r^C$.

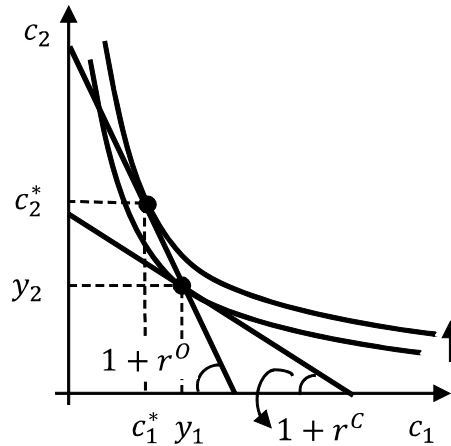


FIG. 6.

With the higher interest rate and the possibility of exporting part of the production, country A will substitute away consumption in period 1 toward consumption in period 2, as shown in figure 6. Consumption in period 1 decreases. The difference $y_1 - c_1$ will be the exports of country A to the countries in region B. As it can be seen in the figure, the new equilibrium is such that the indifference curve shifts upward. So, welfare increases. The possibility of trading with the countries in region B increases welfare.

The implication of the changes in the diagram $r \times Y$ will be a rightward shift to the curve Y^d to $Y^{d'}$, as shown in figure 7. Aggregate demand will now be given by $c_1(r^O)$ plus the goods exported $y_1 - c_1$, $Y^{d'} = C + X - M$, where $C = c_1(r^O)$, $X = y_1 - c_1$, and $M = 0$. Notice that even though consumption decreases in period 1, compared with the situation in which the economy is closed, welfare increases.

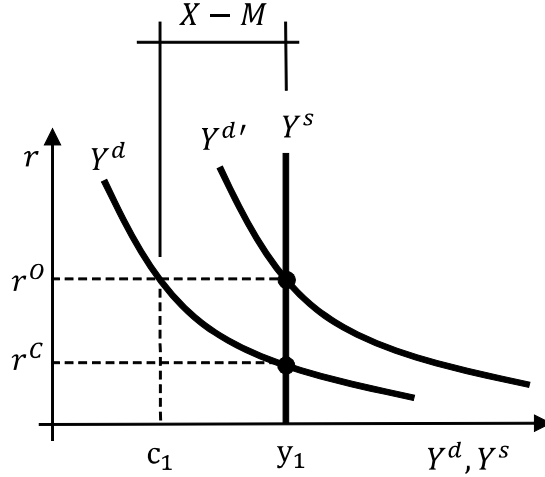


FIG. 7.

In terms of savings, country A now saves $y_1 - c_1 > 0$ in period 1. The savings are exported to region B. In period 2, region B repays the savings exporting part of its production to country A. Country A will import goods from region B so that $c_2 > y_2$.

The question didn't ask, but we can with the information in the question calculate the equilibrium interest rates before and after country A opens for trade.

Before opening for trade, country A had $1 + r^C = \frac{1}{\beta} \frac{y_2}{y_1}$, as we saw in item *a*. With $y_1 = y_2$, this expression implies

$$1 + r^C = \frac{1}{\beta}.$$

After opening for trade, the new interest rate will be such that consumption of

all countries will be equal to the production of all countries, $c_1^A + c_1^B = y_1^A + y_1^B$. Analogously to country A, the countries in region B will have aggregate consumption in period 1 equal to $c_1^B = \frac{1}{1+\beta} \left(y_1^B + \frac{1}{1+r} y_2^B \right)$. So, $c_1^A + c_1^B = y_1^A + y_2^B$

$$\Rightarrow \frac{1}{1+\beta} \left(y_1^A + \frac{1}{1+r} y_2^A \right) + \frac{1}{1+\beta} \left(y_1^B + \frac{1}{1+r} y_2^B \right) = y_1^A + y_1^B$$

$$\Rightarrow 1 + r^O = \frac{1}{\beta} \frac{y_2^A + y_2^B}{y_1^A + y_1^B},$$

which is similar to the expression of item A. The only difference is that now we have to consider output in the two regions. So, the numerator and the denominator above have the sum of the production in the two regions. With $y_1^B = y_1$ and $y_2^B = 2y_1$, we obtain

$$\Rightarrow 1 + r^O = \frac{3}{2} \frac{1}{\beta}.$$

Therefore, the interest rate increases from $\frac{1}{\beta}$ to $\frac{3}{2} \frac{1}{\beta}$.