14.02 Principles of Macroeconomics

Problem Set 3 Solutions

Fall 2017

Question 1 (Chapter 6)

Consider the IS-LM model described in Chapter 6 of the textbook.

(a)

Suppose that the nominal policy rate is $i = 5\%$ and that the expected inflation is $\pi^e = 3\%$. Write an equation for aggregate demand Z (which in equilibrium is equal to Y), specifying the sign of the dependence of each component on Y and $x + r$.

Solution:

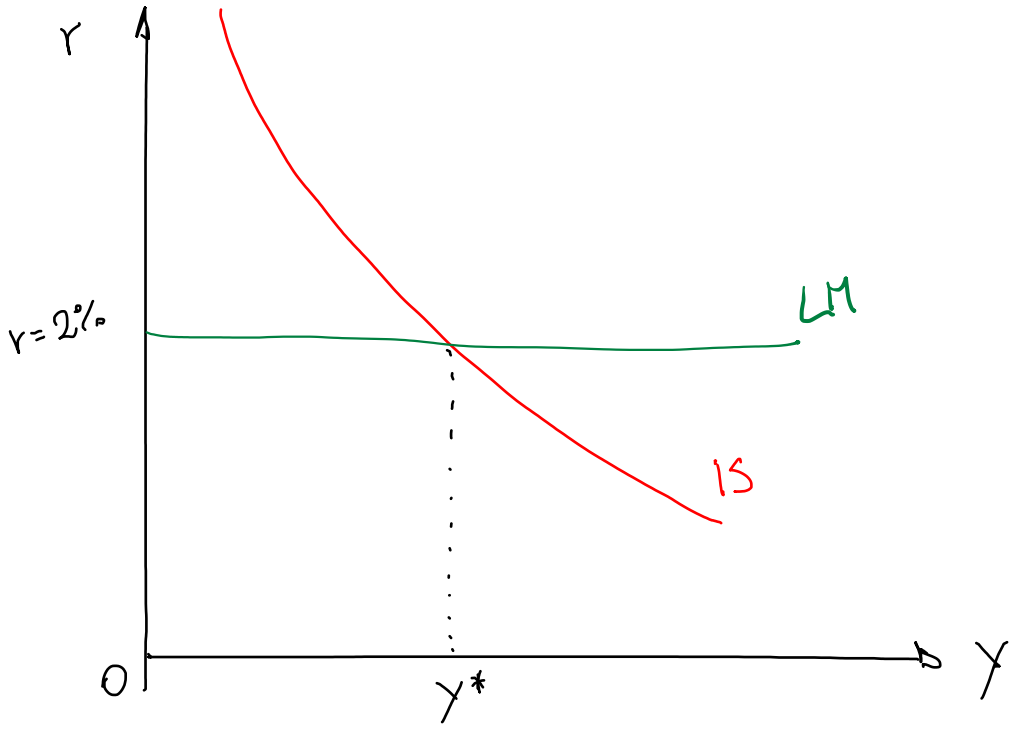
$$Y = C\left(\underset{+}{Y} - T\right) + I\left(\underset{-}{x + r}, \underset{+}{Y}\right) + G$$

(b)

Draw the IS and LM curves with Y on the horizontal axis and r on the vertical axis. Take care to specify the intercept of the LM curve.

Solution: This is the usual graph and the intercept of the LM curve is

$$r = i - \pi^e = 5\% - 3\% = 2\%$$



(c)

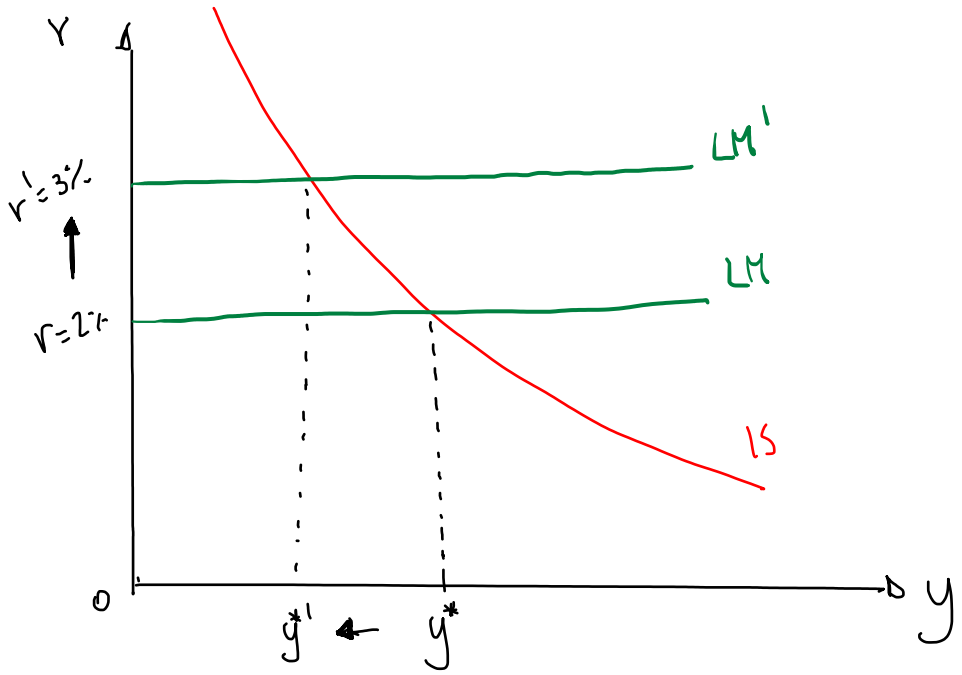
Suppose that expected inflation decreases from 3% to 2%. Does the IS curve shift? Why? You do not need to make a plot to answer this question.

Solution: There is no shift in the IS curve. Indeed, mathematically, for any level of r, the equilibrium output will be the same. This happens because the IS relation is not structurally changed if we view it as a relationship between Y and r. The equilibrium level of output will change, but this is a movement along the IS curve.

(d)

If the Central Bank remains idle, in what direction will equilibrium output change? Why? What's the real interest rate in this case? Draw a new plot portraying both the previous equilibrium and the new one.

Solution: If the CB remains idle, then the real interest rate will be higher. Expecting lower inflation rates, with nominal rates constant, means higher real returns on investments, which shifts the LM curve up. The equilibrium moves along the IS curve and output will be lower. The real interest rate is now $r' = 5\% - 2\% = 3\%$.



(e)

What is the policy response of the central bank, if it wants to bring back output to its original level? How does the intercept of the LM curve change under this policy, compared to a situation where there is no policy? You do not need to make a plot to answer this question.

Solution: Set $i = 4\%$ so that the new real rate is $r' = 2\%$ just as before. This shifts the LM curve downwards.

(f)

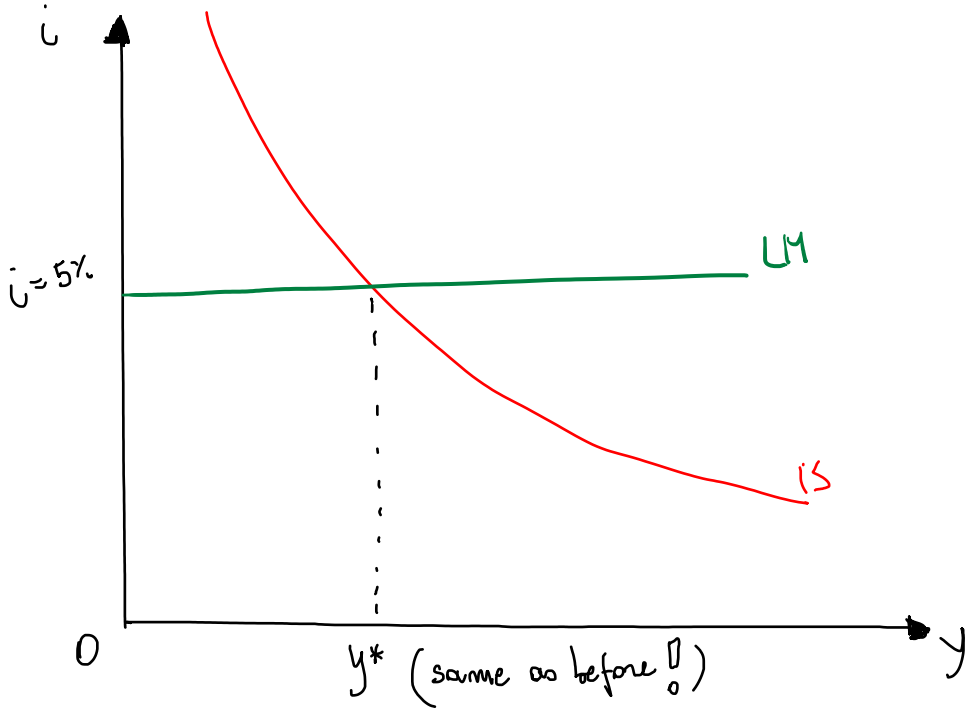
Substitute the definition of the real interest rate in the formula you derived in (a). Draw the IS and LM curves with Y on the horizontal axis and i on the vertical axis. Take care to specify the intercept of the LM curve.

Solution: The formula is:

$$Y = C\left(\underset{+}{Y} - T\right) + I\left(x + \underset{-}{i} - \pi^e, \underset{+}{Y}\right) + G$$

The intercept of the LM curve is:

$$i = 5\%$$



(g)

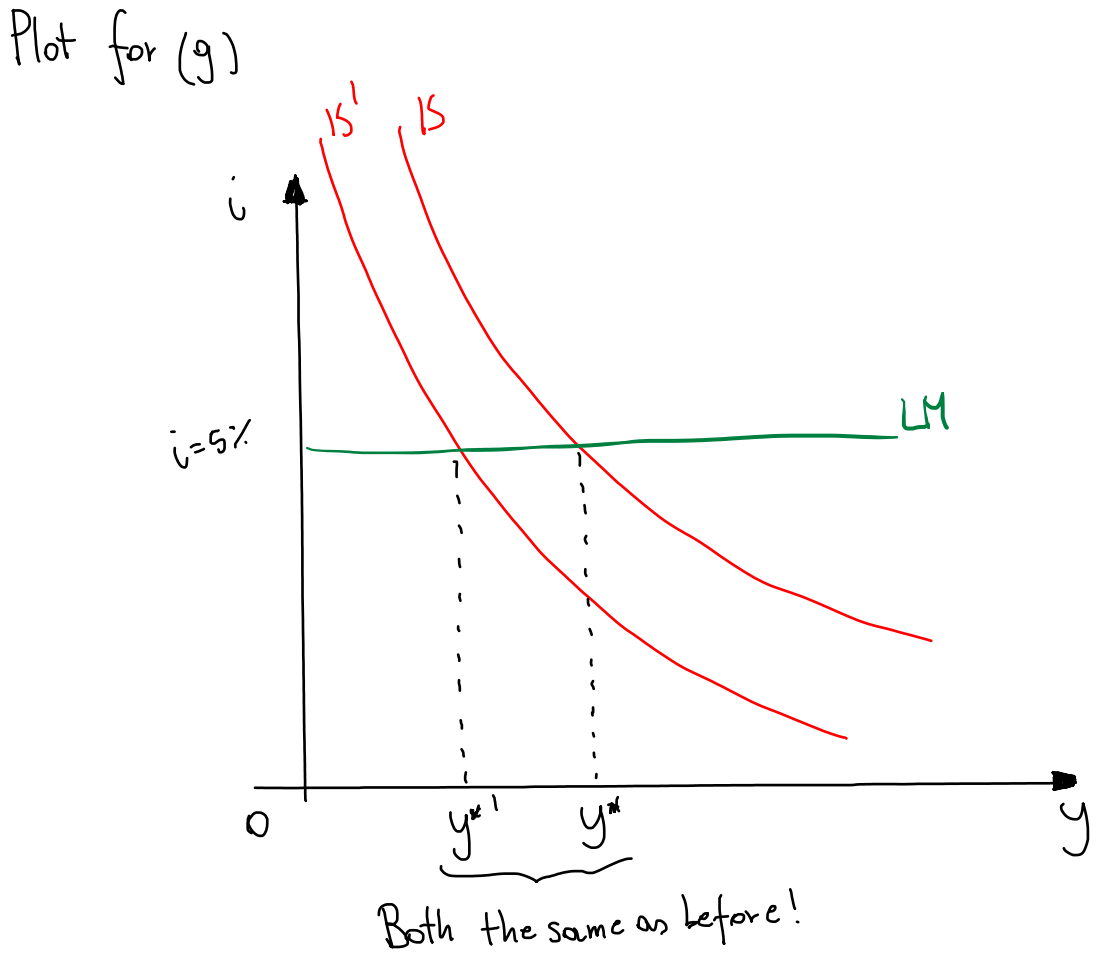
Suppose that expected inflation decreases from 3% to 2%. Does the IS curve shift? Why? What happens to equilibrium output if the Central Bank stays idle? Does it change by more or less compared to (d)? Draw a new plot portraying both the previous equilibrium and the new one.

Solution: Yes, now the IS curve shifts to the left, because it is portrayed as a relationship between Y and i. Since it also depends on π^e, then we can easily see that if $\pi^e \downarrow$, then investment will be lower for any given level of the nominal interest rate i and output Y. Of course, equilibrium output falls by exactly the same amount it did before! Only the representation has changed, not the economics of it.

(h)

What can the Central Bank do to help output recover to its original level? Does the IS, or the LM curve shift? Is the required intervention the same as before? You do not need to make a plot to answer this question.

Solution: The Central Bank can lower the nominal rate to $i = 4\%$ and undo the change in expected inflation. The intervention is the same as before. This will lower the LM curve.



Question 2 (Chapter 7)

Suppose the markup rate is $m = 5\%$ and that the wage setting equation is:

$$W = P^e (1 - u)$$

where u is the unemployment rate and P^e is the expected price level. The price setting equation is given by:

$$P = (1 + m) W$$

(a)

Using the price setting equation, determine the equilibrium real wage, W/P.

Solution:

$$\frac{W}{P} = \frac{1}{1+m} = \frac{1}{1.05} \approx 0.952$$

(b)

Determine the natural rate of unemployment.

Solution: We obtain the natural rate of unemployment by setting $P = P^e$. Then, we have:

$$\frac{1}{1+m} = 1 - u$$

$$u_n = \frac{m}{1+m} \approx 4.76\%$$

(c)

Suppose now that P^e is determined independently of P. Solve for the price P that is determined from the equilibrium in the labor market. You should express P in terms of u, m, and P^e.

Solution:

$$\begin{aligned} P &= (1 + m) W \\ &= (1 + m) P^e (1 - u) \end{aligned}$$

(d)

Suppose the markup increases to $m' = 10\%$. What happens to the real wage and to the natural rate of unemployment? Explain.

Solution: The real wage is:

$$\frac{W}{P} \approx 0.909$$

and the natural rate of unemployment is:

$$u_n = 9\%$$

The increase in the markup lowers the real wage, and the unemployment rate must increase for equilibrium wages to fall.

(e)

Finally, assume that the economy has a total labor force L and a production function given by:

$$Y = N$$

That is, each employed worker produces one unit of output. Express the equilibrium price P found in (c) above in terms of Y, m, P^e, and L.

Solution: First, solve for u as a function of Y:

$$\begin{aligned} u &= \frac{L - N}{L} \\ &= 1 - \frac{N}{L} \\ &= 1 - \frac{Y}{L} \end{aligned}$$

Replacing this formula inside the expression we obtained in point (c), we get:

$$P = (1 + m) P^e \frac{Y}{L}$$

Question 3 (Chapter 7)

Suppose that the non-institutional civilian population of Hairlandia is 250 million, of which 125 million are employed, 14 million are unemployed, and the rest don't have a job and are not actively looking for one.

(a)

How is the labor force defined? What is the labor force of Hairlandia?

Solution: the labor force is defined as the total count of employed and unemployed people. Hence, if L is expressed in millions of dollars:

$$L = 14 + 125 = 139$$

(b)

Define and compute the unemployment rate.

Solution: Unemployment rate is computed as ratio of unemployed to the labor force.

$$u = \frac{14}{125 + 14} \approx 10\%$$

(c)

Define and compute the employment rate.

Solution: The employment rate is defined as the ratio of employment to total non-institutional civilian population.

$$e = \frac{125}{250} = 50\%$$

(d)

Define and compute the labor force participation rate.

Solution: The labor force participation rate is defined as the ratio of labor force to total non-institutional civilian population.

$$lfp = \frac{139}{250} = 55.6\%$$

(e)

Suppose that some unemployed Hairlanders are fed up with the state of the labor market in Hairlandia and stop actively looking for a job. In particular, suppose now there are only 10 million people looking for a job. Compute the unemployment and employment rates. Comment.

Solution:

$$u = \frac{10}{135} \approx 7.4\%$$

$$e = \frac{125}{250} = 50\%$$

We can see that it seems that the state of the labor market has improved from the unemployment rate, even though this may not signal an improvement in the state of the labor market. The employment rate is not affected by this phenomenon.

(f)

Suppose we wish to examine the determinants of the equilibrium real wage and equilibrium level of employment N. In a graph with the real wage on the vertical axis, and the level of employment on the horizontal axis, draw the price-setting and wage-setting relations.

What happens when the markup increases? What happens when unemployment benefits increase? Draw the change in the equilibria in two separate graphs and comment.

Solution: Draw graphs. If markup increases, then price setting equation is lower. This means that, all else equal, employment and the real wage will be lower (movement along the wage-setting curve).

Conversely, if unemployment benefits increase, then at any given real wage, there will be less people willing to work. This means that the wage-setting equation shifts to the left. While the equilibrium real wage does not change, we see a decrease in employment.