

# 14.02 Principles of Macroeconomics

## Problem Set #4 - Answers

October 23, 2002

### 1 PART I. TRUE/FALSE/UNCERTAIN

1. **As in microeconomics, the AD-curve is downward sloping since consumers buy less goods when they are expensive.**

False: the AD-curve is downward sloping because higher a price level reduces the real supply of money ( $M/P$ ). To restore the equilibrium in the money market the interest rate has to increase, so the amount of money demanded in equilibrium is equal to the amount of real money -now lower-. A higher interest rate reduces the level of investment, which implies a lower aggregate demand.

2. **Even with the unemployment rate in its natural level, inflation rate can increase due to higher expected inflation.**

True: if wage setters expect a higher level of inflation (higher expected inflation is equivalent to a higher expected price when current price level is given), they set a higher nominal wage, which leads to a higher price level. Given last period's price level, a future higher price implies a higher inflation rate.

3. **Wage indexation decreases the impact of changes in unemployment rate on the inflation rate.**

False: The extreme case of inflation forecast is the wage indexation. In that case, an increase in prices leads to a further increase in wages within the year, which leads to a further increase in prices, and so on. So the effect of unemployment on inflation within the year is higher.

4. **Expansionary fiscal policy has a positive effect on output, consumption and investment in the short run. However, it has no effect in the medium run since all the components of aggregate demand go back to its previous level.**

False: Investment in the medium run is unambiguously lower.

In the short run, a budget expansion leads to an increase in output. In order to restore the equilibrium in the financial market, an increase in the interest rate is needed to neutralize the positive effect of higher income in the demand of money. Consumption only depends on output, so it increases in the short run. Investment may be lower or higher depending on how sensitive it is to the increase in output versus the increase in the interest rate.

However, as long as the output is above its natural level the price level increases (expected price level increases shifting the AS-curve up). In the medium run, the prices settle down when output is equal to its natural level. Output goes back to its previous level as well as consumption. So, the increase in government expenditure crowds out investment. The contraction in the real amount of money leads to an increase in the interest rate, which -having output constant- ends up in a lower level of investment.

- 5. Expansionary monetary policy has a positive effect on output, consumption and investment in the short run. However, it has no effect in the medium run since all the components of the aggregate demand go back to its previous level.**

True: money is neutral in the medium run.

In the short run, a monetary expansion leads to a decrease in interest rate, which promotes investment and then output and consumption. However, as long as the output is above its natural level the price level increases (expected price level increases shifting the AS-curve up). In the medium run, the prices settle down when output is equal to its natural level. The contraction in the real amount of money completely offsets the previous expansion so the real amount of money, as well as every component of the demand, go back to their previous level.

## 2 PART II: THE AS-AD MODEL

The labor market is characterized by the following equations:

$$W/t = 10 - Z - 10u$$

$$Y = N$$

$$Z = 9$$

$$L = 600$$

$$\mu = 1$$

where  $Z$  stands for unemployment benefits,  $\mu$  for the mark-up margin,  $P^e$  for the expected price level,  $L$  for the total labor force,  $N$  for employment level and  $u$  for unemployment rate.

The money market is characterized by the following equations:

$$\frac{M^d}{P} = 5Y - 1200i$$
$$M^s = 10000$$

And the goods market is characterized by the following equations:

$$I = 100 - 200i + 0.1Y$$
$$C = 120 + 0.4(Y - T)$$
$$G = 400$$
$$T = 400$$

1. **Derive the AD-curve. Explain its meaning and give the intuition for the sign of its slope.**

The equilibrium in the goods market (IS-relation) is reached in every (Y,i) pair such that:  $i = -.0025Y + 2.3$

The equilibrium in the financial market (LM-relation) is reached in every (Y,i) pair such that:  $i = \frac{-25}{3P} + \frac{Y}{240}$

The aggregate demand curve is formed with all those pairs (Y,P) such that both the good market and the financial market are in equilibrium. That is:  $P = \frac{1250.0}{Y-345.0}$

The aggregate demand curve is downward sloping since the higher the price is, the lower the real amount of money in the economy. A monetary contraction leads to higher interest rate, which in turn decreases the level of investment and then, the level of output.

2. **Derive the AS-curve. Explain its meaning and give the intuition for the sign of its slope.**

The AS curve is given by the equation:  $P = P^e(-18 + \frac{1}{30}Y)$ . Along the AS-curve, the labor market is in equilibrium for a given level of  $P^e$ .

The slope of the AS curve is positive because higher level of output implies -for a constant labor force- a lower unemployment rate, which ends up in higher wages. Prices are proportional to wages, so higher output implies higher prices.

3. **What is the natural level of output in this economy? Explain the concept.**

The Wage Setting equation is given by:  $W/P^e = 1 - 10u$

The Price Setting equation is given by:  $W/P = 0.5$

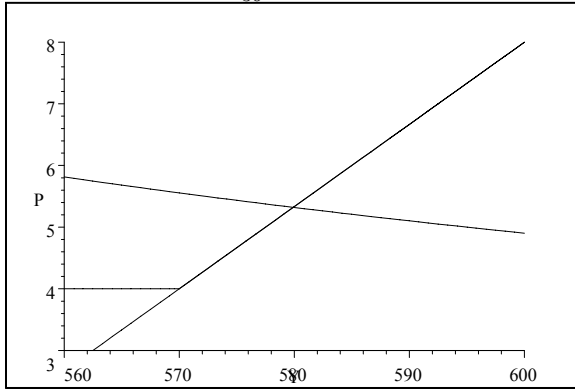
The natural unemployment rate is the one for which the wage setters agree on a real wage equal to 0.5 and do not need to revise their expectations about the price level:  $u^n = .05$ . The corresponding natural level of output is given by  $Y^n = N^n = L(1 - u^n) = 600 * 0.95 = 570$ . At the natural level of output, the wage setters do not need to revise their expectations about prices nor wages.

4. **What is the equilibrium output in the short run, if the expected price level is equal to 4? Show qualitatively with a graph. Explain why having an equilibrium output higher than its natural level implies a price level higher than it was expected.**

The aggregate demand and supply curves are given by:

$$P = \frac{1250.0}{Y-345.0}$$

$$P = P^e(-18 + \frac{1}{30}Y)$$



The equilibrium level of output in the short run is  $Y = 579.91$  and the price level is  $P = 5.3$ . The output level is higher than its natural level, so the price level is higher than its expected value: when the output is above its natural level, the unemployment rate is lower than its natural level which implies a higher nominal wage. The price level is proportional to the nominal wage, so for a level of output higher than the natural level, the price level is higher than it was expected.

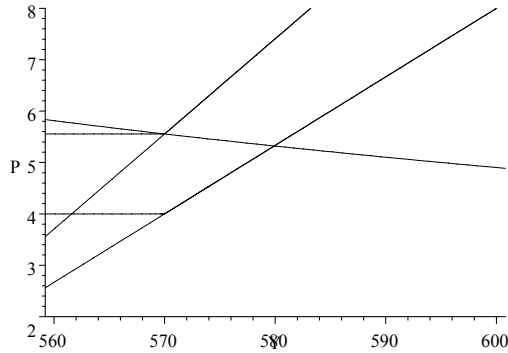
5. **What is the price level in the medium run equilibrium? Explain how the economy evolves from the short run equilibrium to a medium run equilibrium. Illustrate the intuition with both a IS-LM graph and a AS-AD graph.**

In the medium run, the equilibrium output level has to be equal to its natural level ( $Y = 570$ ) and the price level has to be equal to its expected value ( $P = \frac{50}{9}$ ). As long as the output level is higher than its natural level, the price is higher than it was expected and the wage setters keep on revising their expectations and the resulting nominal wage until the discrepancy disappears. Every time the wage setters revise the expected price level, the AS curve shift up. In the medium run, the ultimate AS curve (the curve that corresponds to  $P^e = P$ ) crosses the AD curve in the natural output level.

$$AD : P = \frac{1250}{Y-345}$$

$$AS_{MR} : P = P^e(-18 + \frac{1}{30}Y)$$

$$AS_0 : P = 4(-18 + \frac{1}{30}Y)$$

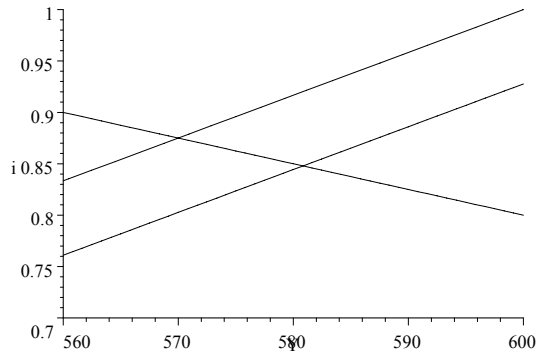


In the IS-LM graph, the evolution from the short run equilibrium to the medium run equilibrium is given by shifts in the LM curve. Every time the wage setters revise their expectations about the future price level, the actual price level increases shifting the LM curve up (higher interest rate and lower income level). The LM curve keeps shifting up till the output level reaches its natural level.

$$IS : i = -.0025Y + 2.3$$

$$LM_{short} : i = \frac{-25}{3*5.3} + \frac{Y}{240}$$

$$LM_{medium} : i = \frac{-25}{3*(50/9)} + \frac{Y}{240}$$



### 3 PART III: SHORT QUESTIONS

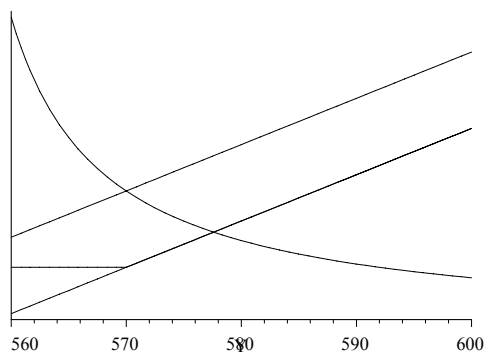
In the late 90s, the unemployment rate was below its historical natural level.

1. Some economists, worried about an increase in prices, recommended the Fed to increase the interest rate.

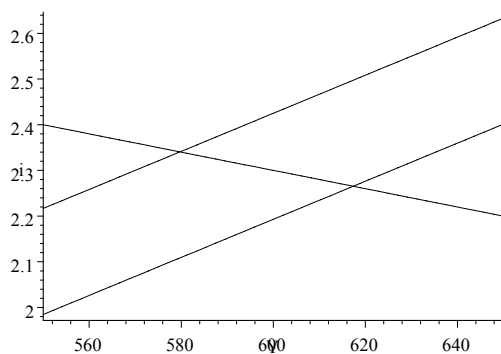
**In terms of the AS-AS, the IS-LM and the WS-PS models, explain the argument above and the consequences of the recommended policy in the short run and in the medium run. Why is that policy appropriate?**

If the unemployment rate is below the natural unemployment rate, which is equivalent to say than the output is higher than its natural level, the prices are going up. The increase in prices contracts the real amount of money in the economy and leads to an increase in the interest rate, which in turn, decreases investment and the output level. The inflationary process takes place till the output goes down to its natural level.

In the AS-AD graph, the initial level of output is higher than the natural level. The AS curve shifts up till the equilibrium output level is the one such that  $P=P^e$ .

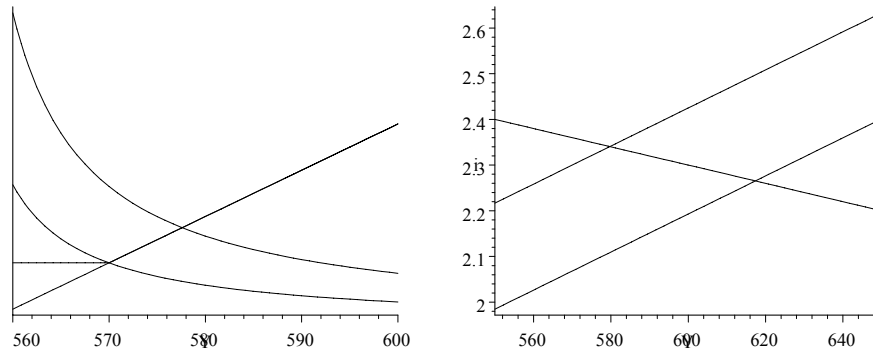


In the IS-LM graph, the LM goes up together with prices.



To avoid inflation, the Fed can induce an increase in interest rate by contracting the monetary supply. The evolution towards the medium run equilibrium takes place without suffering from the inflationary process. In the medium run, the Fed intervention is completely neutral, but it prevents the inflationary process in the short run.

By contracting the amount of money in the economy, the Fed increases the interest rate. So the level of investment and aggregate demand is reduced. This is a shift down in the AD-curve instead of shifting up the AS-curve. Eventually, by reducing the nominal amount of money in the economy, the medium run equilibrium can be reached without increasing prices. The IS-LM graph looks just like before, but the reason for the LM moving is different: the contraction is not given by an increase in prices but an increase in the nominal supply of money, which in turns imply a shift down in the AD curve.

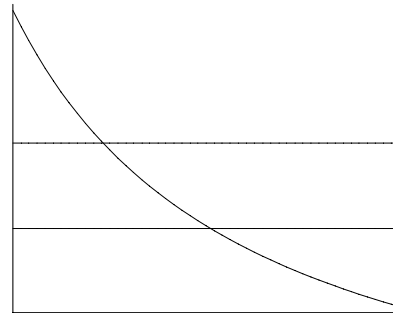
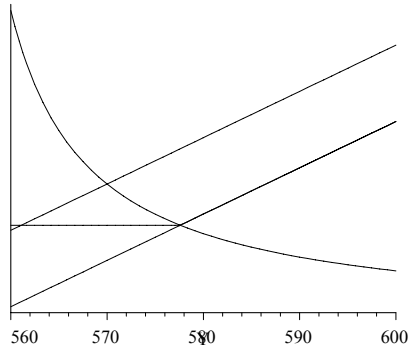


2. **Some other economists argued that the low unemployment rate in the late 90s could not be taken as a sign of future inflation. The evolution of the unemployment rate was due to an increase in the labor productivity.**

**In terms of the AS-AS, the IS-LM and the WS-PS models, explain the argument above.**

An increase in the labor productivity decreases the natural unemployment level (it shifts up the PS curve in the WS-PS graph). For a given mark-up level, the unitary cost decreases and so does the price level. The real wage level is higher so the natural unemployment rate is lower. In the AS-AD graph, an increase in the labor productivity implies a shift to the right in the AS-curve that characterizes the long run equilibrium -i.e. the AS curve for a  $P^e$  equals  $P$ -. Once the economy has a lower natural unemployment rate, the economy evolves towards a higher level of output. The evolution includes a decrease in the price level which leads to an expansion of the real amount of money. The real monetary expansion increases the investment level and output. In the medium run, the output level increases to its new natural level, the unemployment rate decreases to its new natural level, with stable prices and wages.

The new level of output might seem above its natural level if we do not realize that the medium run AS-curve shift to the right, but it is in the new natural level implied by the higher labor productivity.



3. **What are the short run and long run consequences of implementing the policy recommended in 1 when the right diagnosis is the one given in 2?**

A contractionary monetary policy will delay the economy in reaching the new natural level of output. The natural evolution of the economy involves a real monetary expansion given by the decrease in the price level (shifts to the right in the LM curve). So a monetary contraction (shifts to the left the LM curve) would require a larger deflationary process in order to reach the medium run equilibrium. The price level has to decrease even more so to undo the Fed's monetary contraction, plus induce the interest rate to decrease further than its original level so the output increases to its new natural level.

In the AS-AD graph, the monetary contraction shifts the AD curve to the left, while the economy is going to its medium run equilibrium by reducing the price level (shifting the AS curve to the right). The resulting equilibrium has a very low price level, but the monetary policy is still neutral in the medium run.

