

METU Department of Economics

ECON202 Macroeconomic Theory I (Sec. 2)

Fall 2025

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PROBLEM SET 5

PART A: TRUE/FALSE

- 1) “Unemployment rate” and “nonemployment rate” are synonyms.

False. The first is the ratio of unemployed to labor force . The second is the ratio of population minus employment to to population.

- 2) In an economy where product markets are not perfectly competitive (that is firms can charge prices higher than the marginal cost), it is always optimal for a profit maximizing firm to choose a combination of price P and markup μ such that

$$\frac{P}{1+\mu} = W \text{ reservation wage}$$

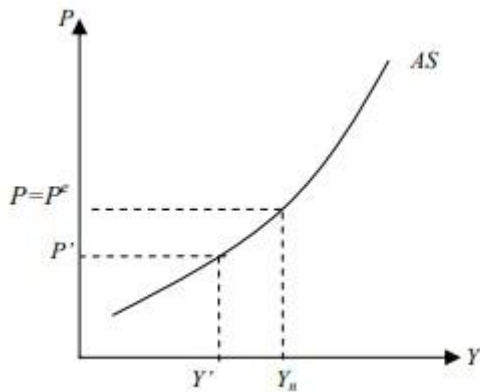
True for the textbook definition, if all workers have same level of productivity, the real wage equals to 1 divided to $(1+\mu)$ from the wage setting equation. However, it is FALSE if efficiency wage theories explain, sometimes firms may want to pay more than the reservation wage in order to motivate workers to be more productive.

- 3) An increase in the workers bargaining power leads to an increase in the equilibrium nominal wage; however the equilibrium real wage stays constant

True. In our setting, the equilibrium real wage is fully determined by the price setters. The nominal equilibrium wage increases if workers’ bargaining power goes up, but the equilibrium price level also increases (the increase in bargaining power would be reflected in an increase in z , which shifts AS curve to the left, and decreases the natural level of output.

- 4) When output is below the natural level of output, the actual price level is lower than the expected price level.

True. The actual price level equals the expected price level when output is equal to the natural level of output. Because the AS curve is upward-sloping, if output is below its natural level, the actual price level is lower than expected. See diagram:



- 5) In terms of changing output, monetary policy is relatively more effective in the short run when the AS curve is relatively flat, while fiscal policy is more effective when the AS curve is relatively steep.

False. Monetary and fiscal policies affect the AD curve, not the AS curve. Monetary and fiscal policies are both more effective in changing output when the AS curve is flatter and ___ less effective when the AS curve is steeper. In the extreme case, when the AS curve is vertical, neither policy has any effect on output (the only effect of monetary and fiscal policy in this case is a change in the price level).

- 6) The neutrality of money suggest that monetary policy should not be conducted to affect output.

False. It is true that in the medium run, the increase in nominal money is reflected entirely in a proportional increase in the price level, and therefore the increase in nominal money has no effect on output or on the interest rate. However, the neutrality of money in the medium run does not mean that monetary policy cannot or should not be used to affect output: a monetary expansion can, for instance, help the economy move out of a recession and return faster to the natural level of output. In fact, in the short run, an increase in the money supply leads to an increase in output, an increase in the price level, and a decrease in the interest rate. What the term implies is that monetary policy cannot sustain higher output forever

- 7) The AD curve is the sum of all the market demand curves in the economy.

False. AD curve represents the equilibrium points that IS and LM curves intersect at a certain price level.

- 8) The greater the interest sensitivity of investment, the flatter the aggregate demand curve.

TRUE. If investment is very sensitive to the interest rate, then a change in the real money stock due to a price decrease has a strong effect on the output demanded. As prices decrease, real money balances increase and the LM curve shifts to the right. This translates into a movement along the AD-curve. If investment becomes more sensitive to changes in the interest rate, the IS curve becomes flatter and

income increases more as the LM curve shifts to the right due to the decrease in the price level. The AD curve therefore also becomes flatter.

- 9) In the medium run monetary and fiscal policies are neutral.

FALSE. Both fiscal and monetary policies do not affect the medium run output equilibrium level. Monetary policy doesn't affect the medium run interest rate either -its effect is just on prices. This phenomenon leads economists to speak about the "neutrality of monetary policy". Fiscal policy affects the medium run interest rate and the medium run level of investment, which implies that it is not neutral.

PART B: LONG QUESTIONS

- 1) Suppose that firm's mark-up over costs is 20%, and the bargaining function is given by $F(u, z) = z - 180u$, where $z = 90$, and u is the unemployment rate.

- a) What is the real wage as determined by the price – setting equation?

$$F(u, z) = z - 180u, z=90$$

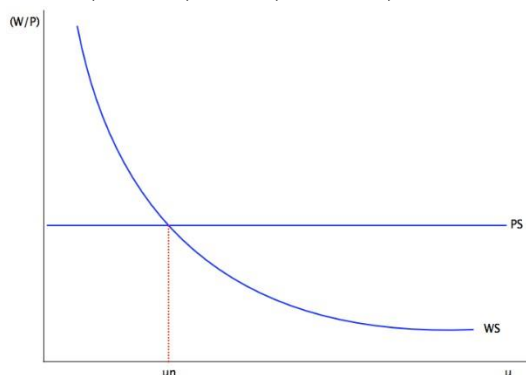
$$P=(1+m).W$$

$$\frac{W}{P} = \frac{1}{1+m} = \frac{1}{1+0.2} = 0.83 \text{ (approximately)}$$

- b) What is the natural rate of unemployment?

$$W=P \cdot F(u, z)$$

$$W=P^e (z-180u) = P^e (90-180u)$$



At the equilibrium $P = P^e \rightarrow w = 90 - 180u$
 P

From price setting equation, $\frac{w}{P} = 0.83$

$$0.83 = 90 - 180u_n \rightarrow u_n = 0.4954$$

- c) Suppose that the mark – up of prices over costs decreases by 10%. What happens to the natural rate? Explain the logic behind your answer.

$$\frac{w}{P} = \frac{1}{1+m} = \frac{1}{1+0.1} = 0.90 \text{ (approximately)}$$

$$0.90 = 90 - 180u_n \rightarrow u_n = 0.4949$$

Natural rate of unemployment decreased. (For more detailed information, read p143 from our textbook)

- d) Suppose the labor productivity coefficient is 120, and the labor force is normalized to one. Calculate the natural levels of output implied by parts (b) and (c)

$$Y = A \cdot N, A = 120$$

In part b, we found $u_n = 0.4954$, and in part c we found $u_n = 0.4949$

$$N = L(1-u), N_n = L(1-u_n) \text{ where } L \text{ is the labor force}$$

$$Y_n = N_n \cdot 120 \rightarrow 120(1-0.4954) = 60.552 \text{ for b}$$

$$Y_n = N_n \cdot 120 \rightarrow 120(1-0.4949) = 60.612 \text{ for c}$$

- 2) Suppose that the labor market is described by the following equations

$$W = P \cdot z \cdot (1-u)/u$$

$$P = (1 + \mu) \cdot W$$

$$Y = N$$

Here z is the variable catching institutional effects on wage setting, such as unemployment benefits, W is the mark – up of prices over wages.

- a) Assume initially that $z = 1$. Solve for the equilibrium real wage, unemployment and output.

If $z=1$, $\frac{w}{p} = \left(\frac{1-u}{u}\right)$

from wage setting equation,

And $\frac{w}{p} = \left(\frac{1}{1+m}\right)$ from price setting equation

At the equilibrium, these two must be equal, that is

$$\left(\frac{1-u}{u}\right) = \left(\frac{1}{1+m}\right)$$

$$u = \frac{1+m}{2+m}$$

Is the natural rate of unemployment

$Y = A \cdot N$ and assume that $A=1$, $Y=N$, $Y = L-U = L-u(L) = L(1-u)$

We found that $u = \frac{1+m}{2+m}$, plug this into equation, $Y = L\left(\frac{1}{2+m}\right)$

Equilibrium Real wage is W/P

- b) The government decides to increase unemployment benefits. This results in z increasing to 2. Solve for the new equilibrium real wage, unemployment and output.

If $z=2$, $\frac{w}{p} = 2 \left(\frac{1-u}{u}\right)$

from wage setting equation,

And $\frac{w}{p} = \left(\frac{1}{1+m}\right)$ from price setting equation

At the equilibrium, these two must be equal, that is

$$2 \left(\frac{1-u}{u}\right) = \left(\frac{1}{1+m}\right)$$

$$u = \frac{2+2m}{3+2m}$$

Is the natural rate of unemployment

like the previous, $L(1-u)=Y$ plug this u into the equation,

$$Y = L\left(\frac{1}{3+2m}\right)$$

- c) Suppose that the mark-up rate, instead of being fixed, depends on the unemployment rate. The new mark-up rate is given by $\mu = \frac{1-u}{2}$. Solve for the equilibrium output, natural level of unemployment and real wage. In addition, compare the effect of increase in z to unemployment rate in a and b.

Mark-up depends on unemployment, not fixed

$$\text{PS: } P = \left(1 + \frac{1-u}{2}\right) W$$

$$\text{WS: } W = P z \left(\frac{1-u}{u}\right)$$

WS and PS are equal at the equilibrium, and $P=P^e$ (this is why we wrote like this)

$$z=1, \frac{w}{p} = \left(\frac{1-u}{u}\right),$$

$$\frac{u}{1-u} = 1 + \frac{1-u}{2}$$

$$\frac{u}{1-u} = \frac{3-u}{2}$$

$$2u = 3-u-3u+u^2 \Rightarrow u = 0.55 \text{ (approximately)}$$

$$, \frac{w}{p} = 0.81 \quad Y = (1-u) \cdot L = 0.45 L$$

When $z=2$ the same procedure gives $u=0.69$ real wage= 0.868 and $Y= 0.31L$

In part b, when z increases from 1 to 2, the natural rate of unemployment increased.

$$\frac{1+m}{2+m} < \frac{2+2m}{3+2m}$$

3) Suppose Mervia, a closed economy, is defined by the following equations:

$$C = 20 + 0.5Y_d$$

$$I = 120 - 4i$$

$$M_d = P(254.5 + 0.6Y - 6i)$$

$$M_s = 220$$

$$Y_{\text{potential}} = 150$$

$$G = G_0$$

$$T = 0$$

where i is the interest rate (percent), P is the price level (index number), Y is GDP and $Y_{\text{potential}}$ is the GDP level attained at the natural rate of unemployment.

a) Derive the Aggregate Demand curve of Mervia

$$\text{IS: } Y = C + I + G$$

$$i = \frac{1}{4}(140 - 0.5Y + G_0)$$

$$\text{LM: } M_s = M_d \rightarrow$$

$$i = \frac{254.5}{6} + 0.1Y - \frac{220}{6P}$$

$$P = \frac{440}{89 + 2.7Y - 3G_0}$$

Combining the 2 equations, AD:

$$\frac{1}{100}$$

b) The Aggregate Supply curve of Antarctica is given by: $P = P^e + \frac{1}{100}(Y - Y_{\text{potential}})$ where P^e is the expected price level. Briefly explain, using economic intuition, why the overall price index, P , depends on P^e and $(Y - Y_{\text{potential}})$. When $P = 1$ and $G_0 = 0$, calculate the value of P^e and Y .

The larger $(Y - Y_{\text{potential}})$ is, the greater the upward pressure on input costs (in particular labor costs due to shortages of labor in booms). The increase in costs includes an upward shift of the short run AS curve and thus an increase in P . Regarding the expected price levels, there are several explanations. First, when firms expect prices to increase, they will increase their output prices if they want to keep their profit margins (difference between marginal costs and marginal revenues). Second, future higher expected prices will affect wage negotiations and thus labor costs. The higher expected future prices, the stronger the demand for higher nominal wages, which will tend to increase final output prices, making expectations correct.

From the AD curve derived in (a), we know that:

If $P=1$ and $G_0=0 \rightarrow 1 = \frac{440}{89 + 2.7Y} \rightarrow Y = 130$

Combining this with the AS curve, we get:

$$1 = P^e + \frac{1}{100}(130 - 150) \rightarrow 1 = P^e - 0.2 \rightarrow P^e = 1.2$$

- c) Suppose that there is a high rate of unemployment in Mervia. To convince people to remain in this paradise, the government decides to attain $Y_{potential}$ through monetary and/or fiscal policies. What will the overall price level be if the government is successful in attaining $Y_{potential}$? (Use P^e from above).

Fiscal or monetary policy changes will shift the AD curve. Thus, the AD curve derived above is valid if $M_s = 220$ and $G_0 = 0$. On the other hand, the AS curve doesn't shift if price expectations remain unchanged. Thus, we can use the AS curve to derive what the overall price level will be if $Y = Y_{potential} = 150$ and $P^e = 1.2$:

$$P = P^e + \frac{1}{100}(Y - Y_{potential}) = 1.2 + \frac{1}{100}(150 - 150) \rightarrow P = 1.2$$

In order to find the new money supply, we derive AD curve, starting from the LM curve.

The equilibrium in money market = $P(254.5 + 0.6Y - 6i) = MS'$ let's call it x .

The new LM relation is $i = \frac{254.5}{6} + 0.1Y - \frac{x}{6P}$

Combine these two to derive the new AD curve (IS=LM i = equations)

$$\begin{aligned} \frac{140}{4} - \frac{Y}{8} &= \frac{254.5}{6} + 0.1Y - \frac{x}{6P} \\ \frac{9Y}{40} + 7416 &= \frac{x}{6P} \end{aligned}$$

We have $Y=150$ as target GDP and $P=1.2$ is given in the question, $x= 296.4$

The money supply should be 296.4 (approximately) to reach the potential output.

- 4) Consider the closed economy IS/LM – AS/AD model covered in class. You may find it useful to draw out these graphs in answering the equations, but they are not necessary for the solution.

$$IS: Y = C(Y - T) + I(Y, i) + G$$

$$LM: \frac{MS}{P} = Md(i, Y)$$

$$AS: P = PeF(u, z)[1 + m]$$

Investment has initial value I_0 . Output is initially at the natural level Y^n . Consider an increase in government spending $\Delta G > 0$. Assume for now that both price and expected price are fixed. Also assume throughout that government does not implement any other policy than what is stated.

- a) Denote the resulting investment level I_1 . How does I_1 compare to I_0 ?

[Solution: Indeterminate]

[Explanation: With an increase in government spending, IS shift outward, along the (positively sloped) LM curve. Note that since price is fixed, LM does not shift. This results in increase in both output and interest rate. Now consider $I(Y, i)$. It is increasing in Y but decreasing in i . As such the effect on investment is indeterminate. On the one hand investment increases since output increase. However it also decreases since interest rate increases. I_1 can either be higher or lower than I_0 .]

Now assume that price is flexible, but expected price is still fixed.

- b) How does price P compare with initial value?

[Solution: Price Increases]

[Explanation: The outward shift on IS translates to an outward shift in AD. Since AS is upward sloping, this results in a higher price. Note that AS does not shift since expected price is still fixed]

- c) How does real money demand M^d compare with initial value?

[Solution: M^d Decrease]

[Explanation: From b. we know that price increases. Since nominal money supply is constant, this implies that real money supply decreases. Equilibrium in the money market state that real money supply equal to real money demand, so real money demand also decreases]

- d) Denote the resulting investment level I_2 . How does I_2 compare to I_1 ?

[Solution: $I_2 < I_1$]

[Explanation: A decrease in real money supply shift LM inwards. This leads to a decrease in output and higher interest rate, when compare to the situation when price was fixed. Both decreasing output and higher interest rate result in lower Investment]

- 5) Starting from the wage setting relation and the price setting relation, derive an expression for aggregate supply. Make sure you clearly explain each steps in derivation.

Wage setting relation : $W = P^e * F(u, z)$, Wage is a function expected price level P^e , unemployment rate u , and an all-encompassing variable z that captures, among other thing, unemployment benefits and factors that affect bargaining power of labor.

Price setting relation : $P=W(1+\mu)$, price set by firms is a function of wages paid to workers W , types the mark-up $1+ \mu$, which we assume fixed.

In the medium run, $P=P^e$, and real wages and natural rate of unemployment are determined by intersection of WS and PS

Unemployment rate, $u=U/L=(L-N)/L=1-(N/L)$, where U is unemployment, L labor force, N employment

Assume production function $Y=AN$, where A is labor productivity and N is employment

We end up with $u=1-Y/L$

WS relation: $W = P^e * F(u, z) = P^e * F(u, z)$

PS relation: $W = \frac{P}{1+\mu}$

Setting WS=PS, then AS relation: $P = P^e * (1 + \mu) * F(u, z)$

- 6) A new source of energy has been discovered in Macronesia. This new technology will reduce the costs of production of macronesian firms, and as a consequence will reduce the mark-up of price over wage charged by firms. (The change in the mark-up is the only way in which the new technology affects the economy.)

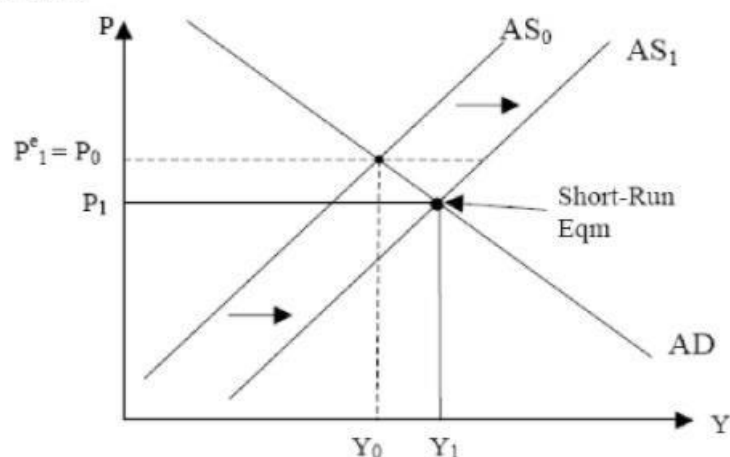
As the finance minister of Macronesia, you would like to analyze the impact of this shock on the economy. Answer the following questions:

- a) In the AS-AD set up, the reduction in production costs shifts which curve, the AS or the AD? How? Explain in words.

Answer: It affects the AS only. For any output level, now the AS curve will relate to a lower price level (AS shifts down in the Y-P diagram).

- b) What happens in the short-run? Show in a graph and describe the effect on the price and the level of output.

Answer:

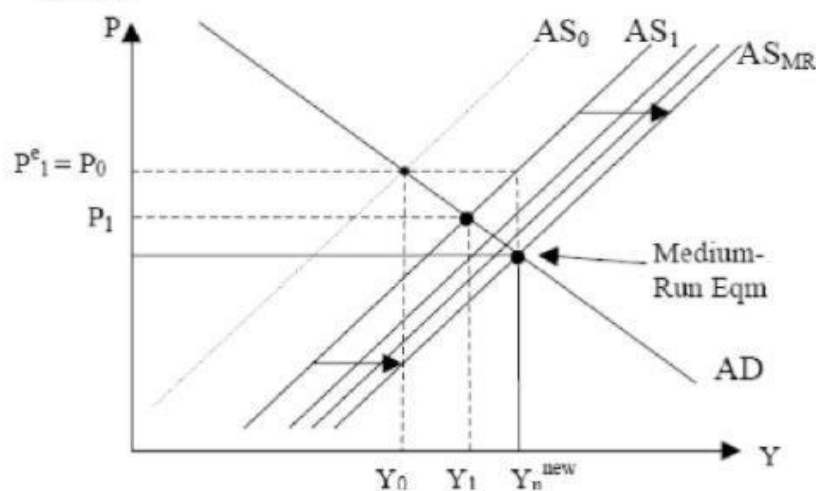


- c) What happens in the medium run?

Answer: Prices decrease even further and output reaches a new higher natural level.

- d) Describe the adjustment from the initial equilibrium towards the medium-run. Show in the graph.

Answer:



- e) Compare the composition of spending (consumption, investment, and government spending) in the medium run with the initial pre-shock situation.

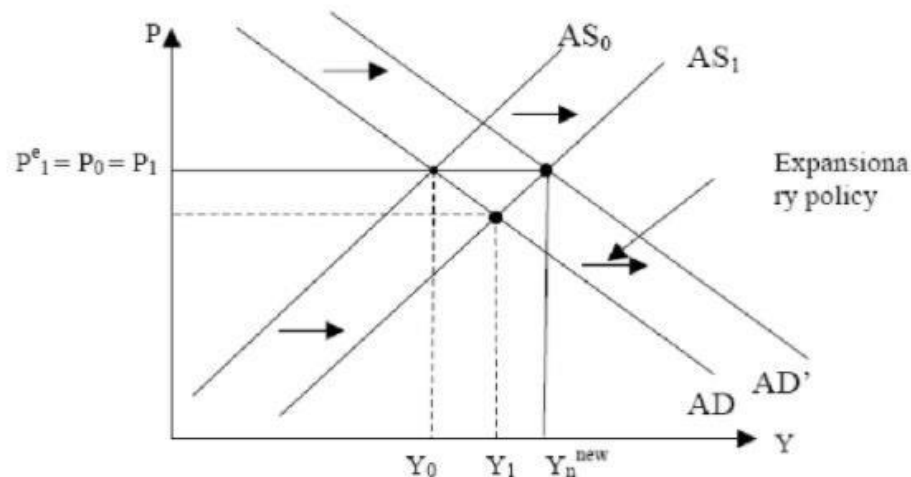
Answer: Recall $Y = C(Y-T) + I(i, Y) + G$

In the new equilibrium, G and T haven't changed. Y is higher, so C has also to be higher. Now we need to see what happens to investment. In the IS-LM diagram, P is decreasing throughout the analysis, so M/P is increasing. The LM is then moving continuously to the right. This in turn implies that the interest rate is going down. In the medium run we are in equilibrium with a lower price level and a lower interest rate. So, as interest rates went down and output went up; investment went unambiguously up.

So, in the medium run equilibrium, C is higher, I is higher and G is the same. The interest rate is lower.

- f) Suppose now that after the initial discovery, you as finance minister would like to accelerate the transition to the medium run by using fiscal or monetary policies. What kind of policies would you recommend? Can you stabilize the economy to its new medium run equilibrium level of output and keep prices constant at the initial level? Show in a graph.

Answer: You would like to expand demand - this could be done with expansionary monetary policy (increasing M) or expansionary fiscal policy (increasing G or reducing T).



- g) Suppose that you achieved the objective in part (f) by changing government spending. What can you say about the new composition of spending (consumption, investment and government spending)?

Recall $Y = C(Y-T) + I(i, Y) + G$

Comparison with pre-shock equilibrium

Output is higher in the medium-run. Given that T is constant, consumption C is higher. Now in the IS-LM diagram, prices do not move (they are kept constant by the expansionary policy), and given that M is constant, the LM does not move. However, G increased, so IS moves to the right. In equilibrium the interest rate is now higher than the pre-shock equilibrium. The effect in investment I is ambiguous.

- h) Compare the composition of spending (Y, C, I, G) and the interest rate in parts (c) and (g).

Answer: Output in the medium run is the same. Consumption is the same. G is obviously higher in part f than in part d. Investment (I) is lower than in part d. The interest rate in part f is higher than in part d.

7) Assume that the following is true about the economy:

$$C = 70 + 0.1(Y - T)$$

$$I = 40 - 200i + 0.1Y$$

$$G = 100$$

$$T = 100$$

$$M^d = \$Y(0.4 - i)$$

$$M^s = 80$$

Assume the following wage setting relation: $W = P^e (z - 30u)$ where $z = \frac{140}{13}$ z : a parameter that represents the workers bargaining power and u is the unemployment rate.

The price setting relation: $P = (1 + \mu) W$ where $\mu = 0.3$ is the markup.

The economy production function: $Y = N$

The labor force: $L = 300$.

a) Derive the AS relation and graph the AS curve.

The AS relation represents the equilibrium points in the labor market.

$$\begin{cases} P = (1 + \mu)W \\ W = P^e (z - 30u) \end{cases}$$

$$P = P^e (1 + \mu)(z - 30u)$$

Given that

$$u = \frac{U}{L} = \frac{L - N}{L} = 1 - \frac{Y}{300}$$

$$\mu = 0.3$$

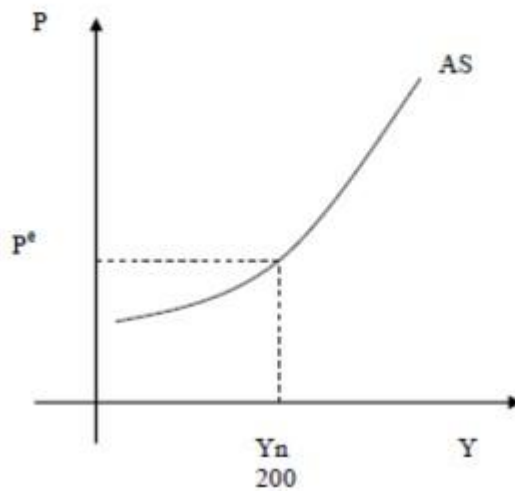
$$z = \frac{140}{13}$$

we get

$$P = P^e (1 + 0.3) \left(\frac{140}{13} - 30 \left(1 - \frac{Y}{300} \right) \right)$$

$$P = P^e \left(\frac{39}{300} Y - 25 \right).$$

The AS curve has to pass through the point (P^e, Y) such that $Y = Y_n = 200$: the natural level of output.



b) Derive the AD relation and graph the AD curve.

The AD relation represents the equilibrium points in the goods market and in the money market.

$$Y = C + I + G = 70 + 0.1(Y - 100) + 40 - 200i + 0.1Y + 100$$

$$Y = 200 + 0.2Y - 200i$$

$$Y = 250 - 250i \text{ (IS relation)}$$

$$M^d = \$Y(0.4 - i)$$

$$M^s = 80$$

$$\text{Given that } \$Y = PY$$

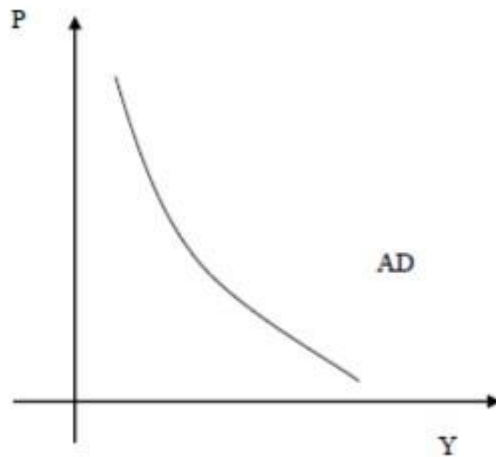
$$80 = PY(0.4 - i)$$

$$i = 0.4 - \frac{80}{PY} \text{ (LM relation)}$$

Combining the IS and LM relations gives

$$Y = 250 - 100 + \frac{20000}{PY}$$

$$Y^2 - 150Y - \frac{20000}{P} = 0$$

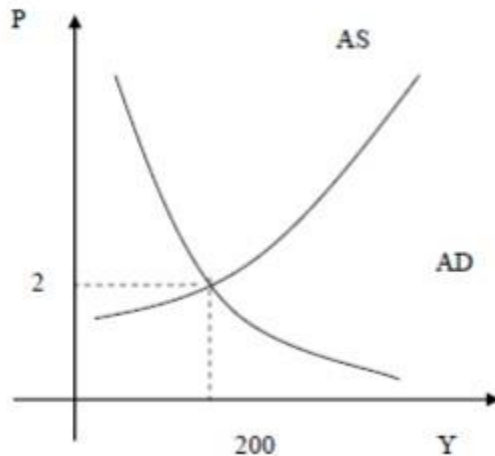


c) Calculate and graph the medium run equilibrium.

In the medium run equilibrium $P = P^e$ and $Y = Y_n = 200$.

$$(200)^2 - 150 * 200 = \frac{20000}{P}$$

$$P = 2$$



- d) Imagine an expansionary monetary policy such that $\Delta = 80$ Ms, that is the money supply increases by 80, from 80 to 160. Assume two different scenarios:

- $P^e \neq P$ (Expectations can differ from the actual price level in the short run);
- $P^e = P$ (Expectations are always equal to the actual price level).

Describe the short run equilibriums in both scenarios – you need to do calculations only for the second case which is given $P^e = P$.

- **$P^e \neq P$ (Expectations can differ from the actual price level in the short run);**

If $P^e \neq P$, the monetary policy can have a real effect in the short run.

The increase in the money supply shifts the AD curve to the right. This implies an increase in both price level and output.

If, at the same time, the expectations of the price level adjust upwards, the AS curve shifts up. This movement can dampen or annihilate the expansionary effect on output (depending on how much P^e increases).

- **$P^e = P$ (Expectations are always equal to the actual price level).**

If $P^e = P$ the AS curve is a vertical line at $Y=200$.

The new equilibrium P is

$$160 = PY(0.4 - i)$$

$$Y^2 - 150Y - \frac{40000}{P} = 0$$

$$(200)^2 - 150 * 200 = \frac{40000}{P}$$

$$P = 4.$$

