14.02 Quiz 2 Solutions
Fall 2004

Multiple-Choice Questions

1) Consider the wage-setting and price-setting equations we studied in class. Suppose the markup, μ, equals 0.25, and $F(u,z) = 1-u$. What is the natural rate of unemployment in this economy?

    A) 0.2
    B) 0
    C) 0.25
    D) 0.1
    E) 0.5

Answer: A). The wage determination equation is $W=P^e F(u,z)$ or $W=P^e(1-u)$. Since we are in medium-run/long-run equilibrium, $P=P^e \Rightarrow W=P(1-u)$. The price setting equation is $P=W(1+\mu)$. Therefore, $W/P=1/(1+0.25)=0.8$. From the wage determination equation, we get that $W/P=0.8=1-u_n$. Therefore, $u_n = 0.2$.

2) In the medium-run/long-run, a decrease in the budget deficit will produce:

    A) No effect
    B) An increase in investment
    C) An increase in consumption
    D) A decrease in output
    E) No effect on the price level

Answer: B). A decrease in the budget deficit produces a shift of the AD curve to the left. So, in the medium-run/long-run, we will get a decrease in the price level, P, while output will remain unchanged. (Agents are expecting lower prices in the future. Nominal wages fall, and therefore the actual price level decreases. So, the AS curve shifts down, keeping output constant.) From the IS-LM equilibrium, we will have that the interest rate will decrease. Thus, investment will increase, consumption is ambiguous (if the decrease in the budget deficit is achieved using an increase in taxes, consumption will decrease, if not, it will remain constant). Thus, the correct answer is B).

3) Suppose that workers in the Republic of Communia are highly unionized, while workers in the Republic of Individuela are not. In all other respects, the two countries are exactly the same. Which statement is true?

   A) Communia is likely to have a higher natural level of output than Individuela.
   B) **Communia is likely to have a higher natural rate of unemployment than Individuela.**
   C) Wages are probably lower in Communia than in Individuela.
   D) In the short-run, the price level is always lower in Communia than in Individuela.
   E) In the short-run, output is always higher in Communia than in Individuela.

*Answer: **B**). In our model of the labor market, the level of unionization is captured by the variable z, which affects wages positively (the higher unionization, the more collective bargaining power workers have, which most likely leads to higher wages). Recall that the natural level of unemployment is defined by assuming that $P = P^e$ and by finding the intersection of the wage setting relation $W = P^e F(u,z)$ and the price setting relation $P = (1+\mu)W$. Thus, $F(u_n,z) = 1/(1+\mu)$. Higher unionization means that z is higher, which shifts up the wage setting relation and leads to a higher natural rate of unemployment.*
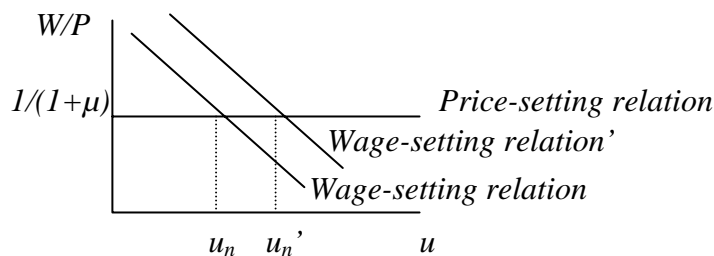
4) Suppose the Phillips curve is given by $\pi_t = \pi_t^e + 0.1 - 3u_t$ where $\pi_t^e = \theta\pi_{t-1}$ Assume that only for the first two periods (t=1 and t=2) people form their expectations using $\theta=0$. From t=3 on, they start using $\theta=1$ forever. Assume that the government still wants to keep unemployment at 2%. What is the expected rate of inflation for t=4?

   A) 2%
   B) 4%
   C) **8%**
   D) 12%
   E) 16%

*Answer: **C**).*
$\pi_t - \pi_{t-1} = 0.1 - 3(0.02) = 0.04$ *(Inflation goes up every period by 4%.)*
$\pi_2 = 0.04$
$\pi_3 = 0.08$ ➔ $\pi_3^e = 0.04$
$\pi_4 = 0.12$ ➔ $\boxed{\pi_4^e = 0.08}$

5) You observe that the domestic interest rate increases from 5% to 15%, and you are in a fixed exchange rate system, then this implies that

    A) The level of the international interest rate increased by 5%
    B) Agents are expecting a nominal appreciation of 5%
    C) Agents are expecting a nominal depreciation of 5%
    D) Both A) and B)
    E) Both A) and C)

*Answer: **E**). Consider the UIP: $i_t = i_t^* + \dfrac{E_{t+1}^e - E_t}{E_t}$. So if the interest rate increases by 10%, the right-hand side of the equation should also increase by 10%. Thus, A) and C) are not enough by themselves. Option B) produces the opposite effect. Thus, E) is the correct answer.*

Long Question I (40/100 points)
Open Economy IS-LM

Assume that the economy is described by the following model:

- $C = c_0 + c_1(Y–T)$, where C is consumption; Y is income; T represents taxes; and c_0 and c_1 are positive constants
- $I = b_1Y – b_2i$, where I is investment; i is the interest rate; and b_1 and b_2 are positive constants

- $G = \overline{G}$, where $\overline{G}$ is a positive constant
- $IM = im_1Y$, where IM is imports; and im_1 is a positive constant
- $X = x_1Y^*$, where X is exports; Y^* is foreign income (exogenous); and x_1 is a positive constant

- The LM equation in this economy is $i = \dfrac{1}{m_2}(m_1Y - M^s)$, where M^s is money supply ($M^s > 1$); and m_1 and m_2 are positive constants
- Let $P^* = P = 1$

Assume that the Marshall-Lerner condition is satisfied (that is, following a depreciation of the exchange rate, the trade balance improves).

Note, given that $IM = im_1Y$ and $X = x_1Y^*$ the Marshall-Lerner condition actually does not hold. NX are actually equation to $x_1Y^* -- \varepsilon(im_1Y)$, and therefore only the only effect of a depreciation is a price effect. As the currency depreciates, ε increases and NX decrease (not increase!). Whether you used the supposition that the Marshall-Lerner condition holds here or if you used the expressions given to you, we gave you full credit.

Part I. Fixed Exchange Rate.

Assume for now that the real exchange rate is fixed at one ($\varepsilon = 1$). Assume that the interest rate parity condition holds, and the interest rate in the foreign country is i^*.

1. Find the expression for equilibrium income. (2 points)

$$Y = C + I + G + X - \varepsilon IM = c_0 + c_1(Y–T) + b_1Y - b_2i^* + \overline{G} + x_1Y^* - (1)(im_1Y)$$

$$Y = \frac{1}{1 - c_1 - b_1 + im_1}(c_0 - c_1T - b_2i^* + \overline{G} + x_1Y^*)$$

2. Calculate the change in output (Y), net exports (NX), the domestic interest rate (i), and the real exchange rate if taxes increase by ΔT. Also draw a diagram. (5 points)

If there is an increase in taxes, the resulting change in income would be

$$\Delta Y = \frac{-c_1}{1 - c_1 - b_1 + im_1} \Delta T \text{ (output decreases by} \frac{c_1}{1 - c_1 - b_1 + im_1} \Delta T).$$

$NX = X - \varepsilon IM = x_1 Y^* - im_1 Y$

$\Delta NX = -im_1 \Delta Y$

$$\Delta NX = \frac{c_1 im_1}{1 - c_1 - b_1 + im_1} \Delta T \text{ (net exports increase by} \frac{c_1 im_1}{1 - c_1 - b_1 + im_1}; \text{ the effect on net}$$

exports comes through the import side).

The domestic interest rate and the real exchange rate do not change, because of the fixed exchange rate regime. So, i=i* and ε=1 (Note that since ε=EP*/P and P=P*=1, ε=E=1.) Money supply must decrease to accommodate the fiscal contraction (monetary policy is endogenous). If it doesn't, the interest rate, i, will decrease to i' (which implies a large depreciation of the exchange rate). But that would break the peg. To bring the interest rate back up to the level i*, the LM curve must shift up.
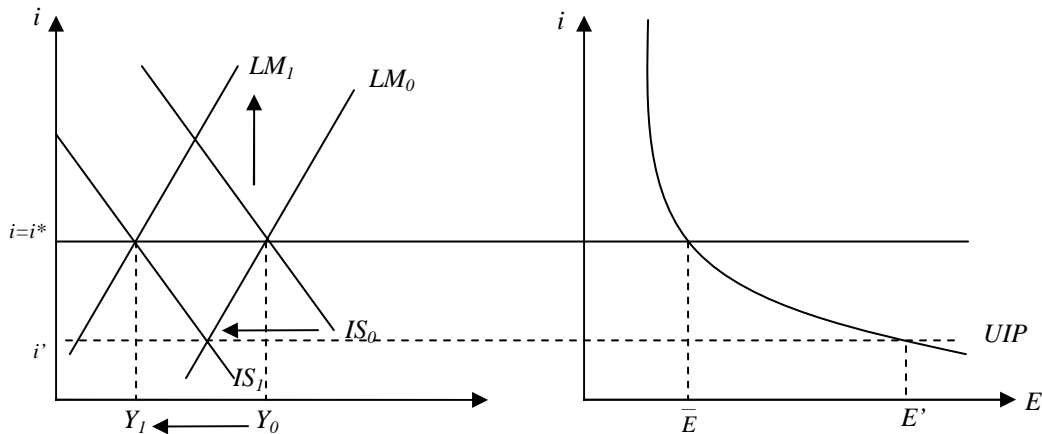
3. Calculate the effect of a change in foreign output (Y*) on domestic output (Y), net exports (NX), the domestic interest rate (i), and the real exchange rate. (Assume that $c_1 + b_1 < 1$.) (4 points)

$$\frac{\partial Y}{\partial Y^*} = \frac{x_1}{1 - c_1 - b_1 + im_1} > 0 \text{ if } c_1 + b_1 < 1 + im_1, \text{ which is true because we are given}$$

that $c_1 + b_1 < 1$.

In general, there are two opposing effects: on one hand, an increase in foreign output, Y*, increases foreign demand, and thus increases domestic exports, which increases Y. On the other hand, higher domestic GDP leads to higher imports. However, we assume that the export effect dominates (because the Marshall-Lerner condition holds).

To answer the part about net exports, we need to solve for NX in terms of only foreign output.

$$NX = x_1 Y^* - im_1 Y = x_1 Y^* - \frac{im_1}{1 - c_1 - b_1 + im_1}(c_0 - c_1 T - b_2 i^* + \overline{G} + x_1 Y^*)$$

$$\frac{\partial NX}{\partial Y^*} = x_1(1 - \frac{im_1}{1 - c_1 - b_1 + im_1}) > 0 \text{ if } c_1 + b_1 < 1 \text{ which is given. (Alternatively, we can}$$

write this as $\Delta NX = x_1(1 - \frac{im_1}{1 - c_1 - b_1 + im_1})\Delta Y^* .)$

Again, there are two opposing effects: on one hand, an increase in foreign output, Y*, increases exports. On the other hand, higher exports result in higher domestic GDP, which leads to higher imports. However, again, the first effect dominates (because the Marshall-Lerner condition is satisfied).

The domestic interest rate and the real exchange rate do not change, because of the fixed exchange rate regime. So, i=i* and ε=1

4. Suppose the Central Bank implements expansionary monetary policy. What effect will this have on output (Y), net exports (NX), the domestic interest rate (i), and the real exchange rate. Also draw a diagram. (4 points)

Expansionary monetary policy has no effect on any of the four variables mentioned in the question, because monetary policy is endogenous in a fixed exchange rate regime.
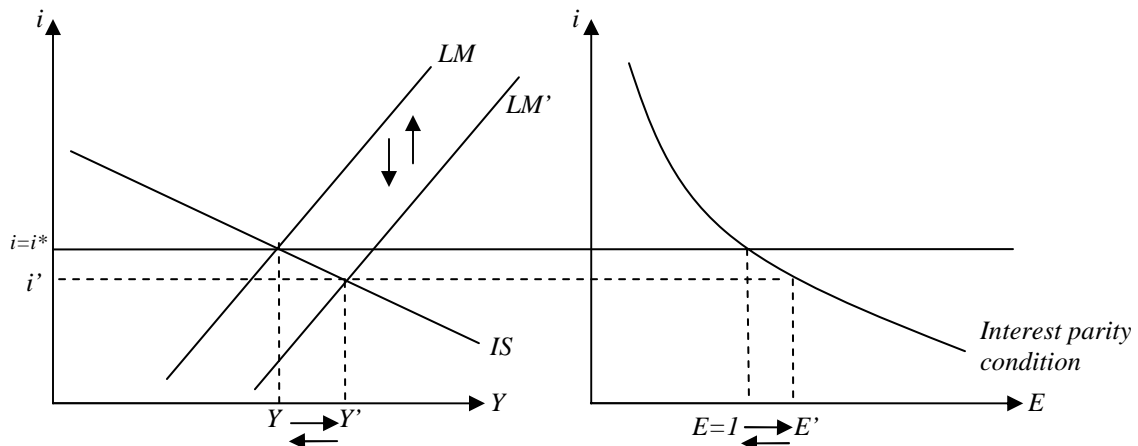
Part II. Flexible Exchange Rate.

Assume that the exchange rate is allowed to float, the interest rate parity condition holds, and that $E^e = 1$.

5. What is the effect on output (Y), net exports (NX), the domestic interest rate (i), and the real exchange rate if taxes increase? Use intuition and draw a diagram (no calculations required). (5 points)

    If taxes increase, the IS curve shifts to the left. Therefore, an increase in taxes will lead to a decrease in output), a decrease in the interest rate, and a depreciation of the exchange rate. What happens to net exports? If you assumed that the Marshall-Lerner condition holds, then net exports increase following this depreciation, because (NX=NX(Y,Y*,E)➔ as output decreases, net exports increase, and as the exchange rate increases (a depreciation), net exports increase, i.e. the two effects go in the same direction. On the other hand, if you used the expressions given to you, the effect on net exports is ambiguous. Output increases and the exchange rate increases. In the expression x_1Y^* -- $\varepsilon(im_1Y)$, Y decreases, while ε increases, making the effect ambiguous. So, we gave credit if you said that the effect on NX is positive or ambiguous.
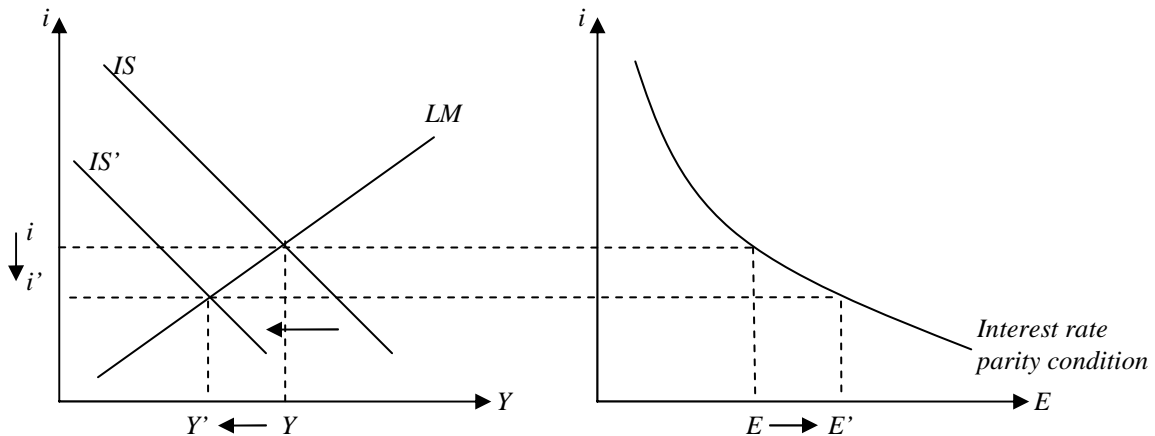
6. What is the effect of an increase in foreign output on domestic output (Y), net exports (NX), the domestic interest rate (i), and the real exchange rate? Use intuition and draw a diagram (no calculations required). (4 points)

    If foreign output increases, the IS curve shifts to the right, because foreign demand rises and they buy more of domestic exports. Therefore, an increase in foreign output will lead to an increase in domestic output, an increase in the interest rate, and an appreciation of the exchange rate. What happens to net exports? NX=NX(Y,Y*,E)➔ the direct channel is that as foreign output increases, net exports increase. But note that there is also an increase in domestic output and a decrease in the exchange rate (an appreciation). So, theoretically, the net effect on net exports is ambiguous

*(whether or not you used the fact that the Marshall-Lerner condition holds).
However, empirically the effect is unambiguously positive (NX increase as Y*
increases). So, we gave credit if you said that the effect on NX is positive or
ambiguous.*
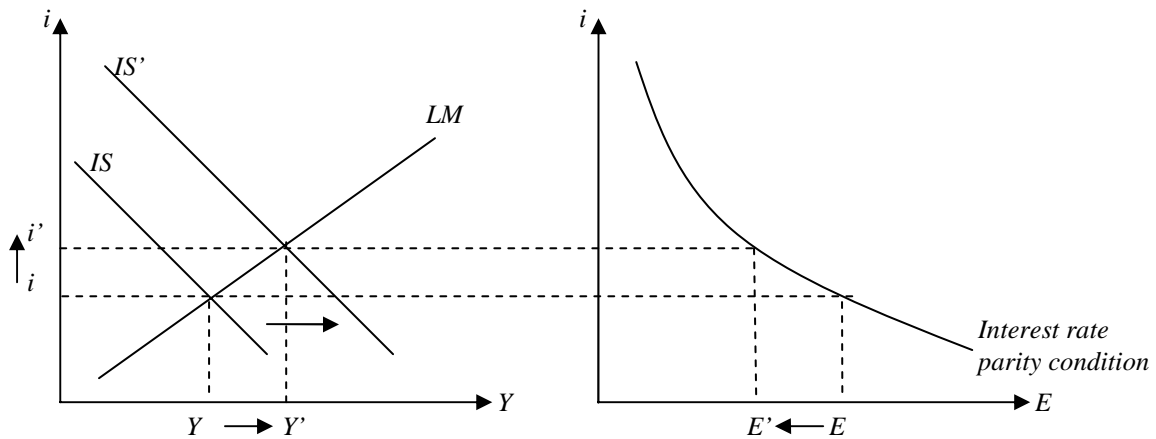
7. What is the effect of an increase in the money supply on output (Y), net exports (NX),
   the domestic interest rate (i), and the real exchange rate? Use intuition and draw a
   diagram (no calculations required). (4 points)

*If money supply increases, the LM curve shifts down and to the right. Therefore,
output increases, interest rate decreases, and the exchange rate depreciates. What
happened to net exports? If you use the assumption that the Marshall-Lerner
condition holds, the effect is ambiguous. Again, remember that $NX=NX(\underset{-}{Y},\underset{+}{Y^*},\underset{+}{E})$. In
this case, output increases, which decreases net exports, but on the other hand, the
exchange rate increases (a depreciation), which increases net exports. What if you
used the math? $NX = x_1Y^* -- \varepsilon(im_1Y)$. We have that Y increases, and ε increases. This
means that NX decreases unambiguously. So, we gave credit if you said that the
effect on NX is negative or ambiguous.*
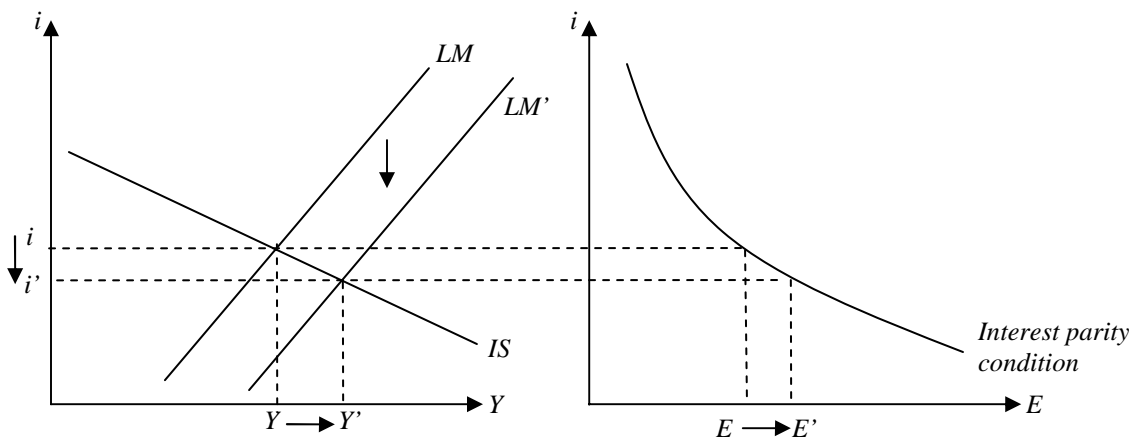
8. Suppose that investors' expectations of the future exchange rate increase (E^e increases). However, the Central Bank does not want the exchange rate to depreciate today. What effect will this have on the economy (no calculations required)? Draw a diagram. (5 points)

The fact that investors expect an increase in E^e in the future will shift the interest-rate-parity-condition (UIP) curve up and to the right. In order to keep the exchange rate from depreciating today, the Central Bank will have to enact a monetary contraction (decrease money supply). This will shift the LM curve up and to the left, bringing the interest rate up to the level (i') at which the exchange rate is at its original level ($\bar{E}$).
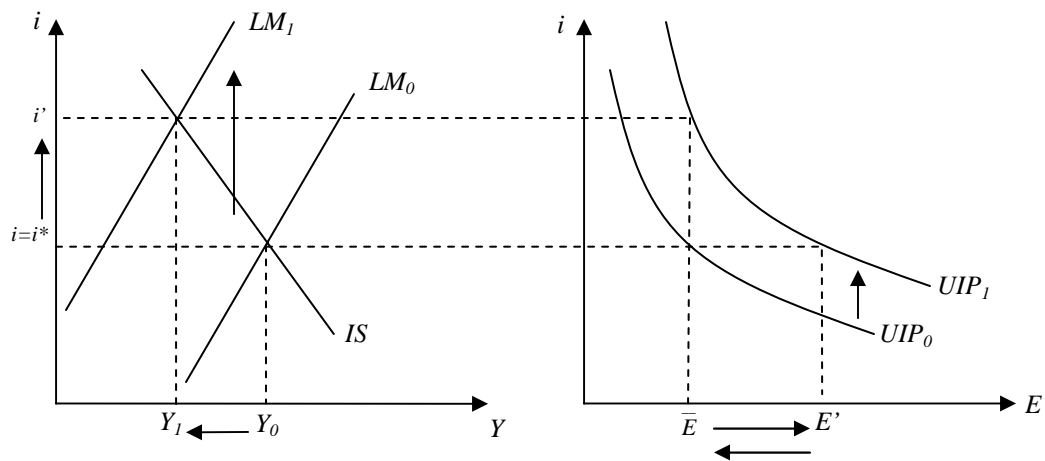
Note that we also gave credit to those of you who said that the IS curve would shift if response to the changing expectation. This is a possible secondary effect that we did not focus on.

Long Question II (40/100 points)
Closed Economy AS-AD

Price Setting Relation: $W = P^e F(u,z)$
Wage Setting Relation: $P = (1 + \mu) W$

Goods Market: $Y = C(Y, T) + I(Y, i) + G$
Financial Market: $M^s = M^d (Y, i) P$

1. Find the aggregate supply relation. Describe the channel through which the AS curve slopes up/down. (5 points)

   Putting together the price setting relation and the wage setting relation,

   AS: $P = P^e (1 + \mu) F(u,z)$

   The AS curve slopes up. (There is a positive relationship between P and Y.) Why? Let us start at a point on the AS curve. Now, if we were to increase Y, then u decreases since u = 1-Y/L. A decrease in u would increase W. This is because with a lower unemployment rate, people demand higher wages. When W increases, P increases since W is part of the input cost for firms. Therefore, there is a positive relationship between Y and P.

2. Assume that the economy is at a point such that the unemployment rate is equal to the natural rate of unemployment. What does this imply about the price level and output? Explain. (5 points)

   When $P = P^e$, we can set the price setting and wage setting relation to each other. This gives us u_N (natural rate of unemployment). In other words, if $u = u_N$, then $P = P^e$.

   If Y = N, then u = 1 – (Y/L). (See pages 136-138)
   Therefore, if $u = u_N$, then $Y = Y_N$.

   The three conditions ($u = u_N$, $Y = Y_N$, and $P = P^e$) give us the same information; the economy is at the medium-run/long-run equilibrium.

3. If the Fed carries out a monetary contraction, what happens in the short-run and the medium-run/long-run? Start from point A where $P = P^e$.

Label the following: all curves including (IS_0, IS_{SR}, IS_{MR}, LM_0, LM_{SR}, LM_{MR}, AD_{SR}, AD_{MR}, AS_{SR}, AS_{MR}), the short-run equilibrium as point B, the medium-run/long-run equilibrium as point C, and output associated with natural rate of unemployment. (10 points)
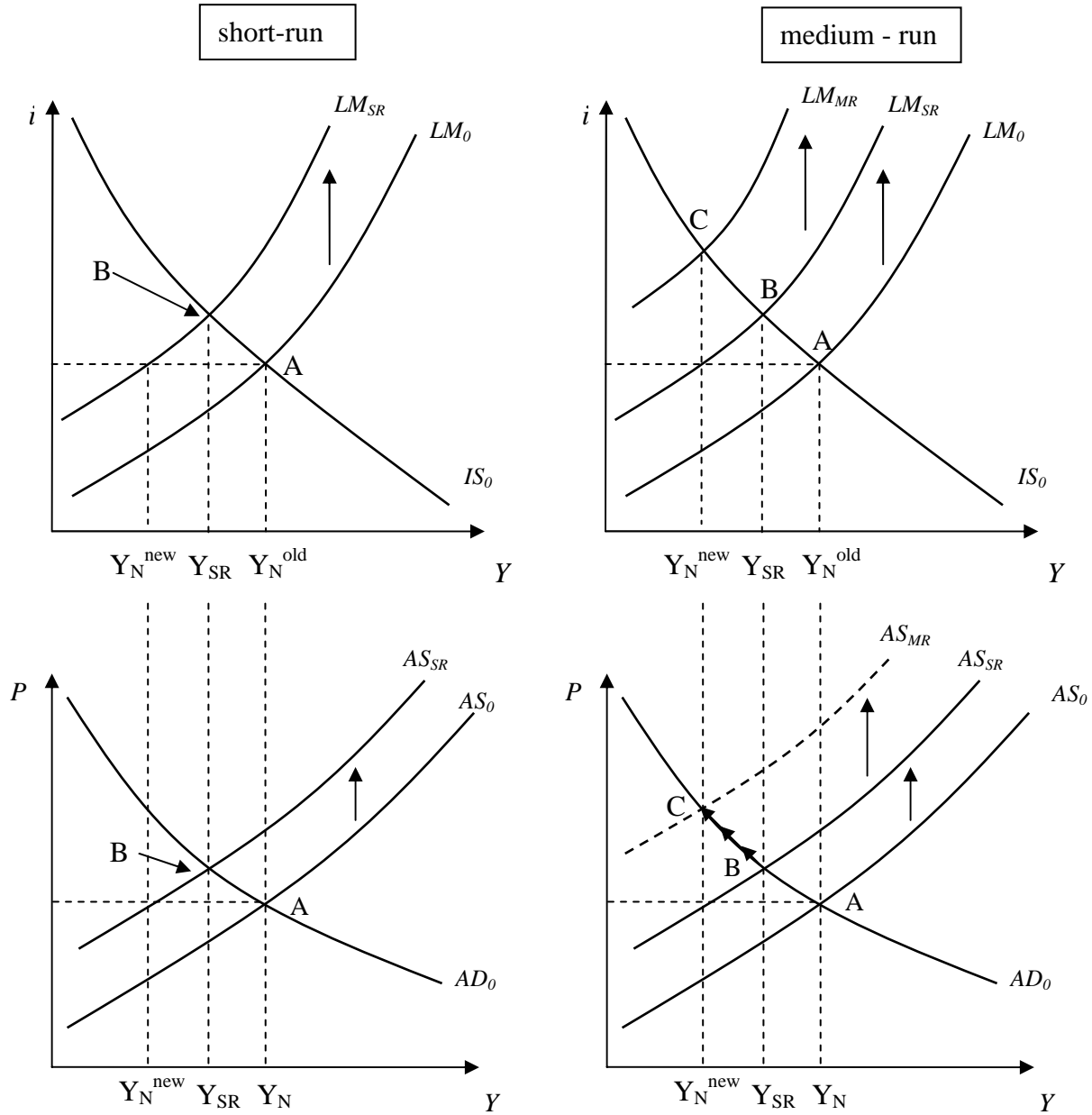

short-run
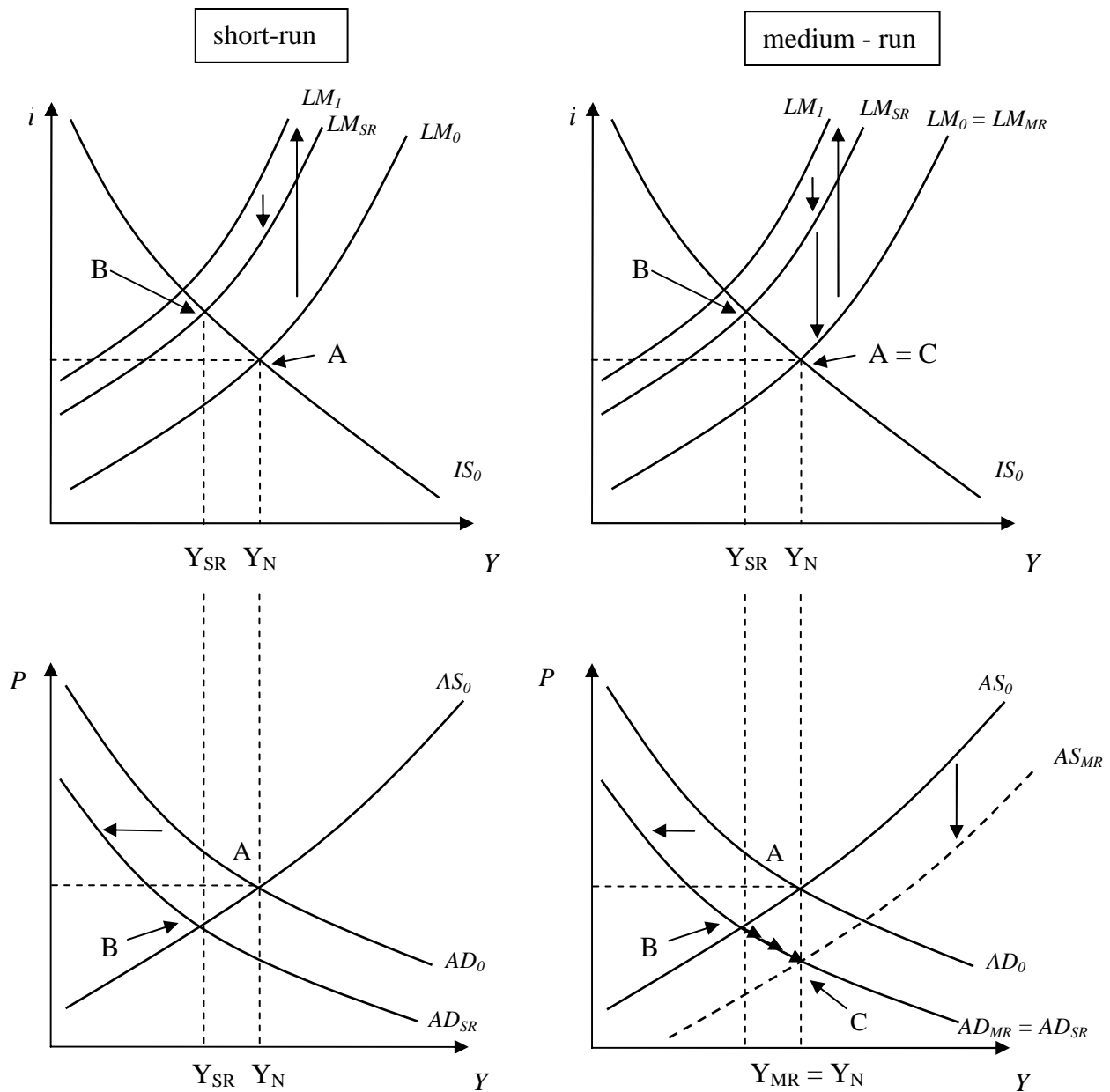
medium - run

4. What does neutrality of money imply about the effectiveness of contractionary monetary policy in affecting output in the short- and medium-run/long-run? Define neutrality of money. (4 points)

    In the short-run, a monetary contraction leads to a decrease in output, an increase in the interest rate, and a decrease in the price level. However, over time, the price level decreases further as the changes in expected price affect the actual price level in the economy. In the medium-run/long-run, the decrease in nominal money has no effect on output or on the interest rate because the decrease in nominal money is matched by a proportional decrease in prices. This phenomenon is called the neutrality of money. Therefore, the neutrality of money holds only in the medium-run/long-run.

5. If the price of oil increases sharply, what happens in the short-run and the medium-run/long-run? Start from point A where $P = P^e$.

   Label the following: all curves including (IS_0, IS_{SR}, IS_{MR}, LM_0, LM_{SR}, LM_{MR}, AD_{SR}, AD_{MR}, AS_{SR}, AS_{MR}), the short-run equilibrium as point B, the medium-run/long-run equilibrium as point C, and output associated with natural rate of unemployment. (10 points)

5. 6. Indicate whether these variables increase, decrease or remain the same when the price of oil rises sharply. (You may use arrows.) (6 points)

	Y	**Y$_n$**	**P**	**i**	**I**	**P^e**
short-run	*decreases*	*decreases*	*increases*	*increases*	*decreases*	*no change*
medium-run/long-run	*decreases*	*no change*	*increases*	*increases*	*decreases*	*increases*