

# 14.02 Quiz 3

Time Allowed: 90 minutes

Fall 2012

NAME:

MIT ID:

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This quiz has a total of 3 parts/questions. The first part has 13 multiple choice questions where you should select what you think is the best answer from four alternatives.

(Table for grader use only, please do not write)

Question	1	2	3	Total
Score				

## Question 1: Multiple choice [3 points each]

1. Which of the following is not a concern for the adoption of the Euro? (A. That's precisely the major economic reason people want to form a currency union.)
  - (a) European economies are already highly dependent on trade with each other.
  - (b) Some of European economies have rigid labor markets.
  - (c) European economies are subject to uncorrelated shocks.
  - (d) All of the above are concerns.
2. Consider a small open economy (so world prices and interest rates are taken as given) with a flexible exchange rate and perfect capital mobility. Assume that the Marshall-Lerner condition is satisfied. A fiscal contraction will have the short-run effect of (D. a fiscal contraction would shift IS to the left, thus lower the interest rate and, through the UIP, the nominal exchange rate. Net Export will be boosted, which imply an increase in the balance of the current account. Since the sum of current and capital accounts is necessarily zero. That has to decrease the capital account.)
  - (a) increasing the balance of both the current and the capital accounts.
  - (b) decreasing the balance of both the capital and the current accounts.
  - (c) decreasing the balance of the current account, but increasing that of the capital account.
  - (d) decreasing the balance of the capital account, but increasing that of the current account.
3. A country with a fixed exchange rate (C. UIP holds under perfect capital mobility. With a fixed exchange rate, that becomes  $i = i^*$ .)
  - (a) always gives up control of its monetary policy.
  - (b) must open its capital markets.
  - (c) gives up control of its monetary policy if it maintains perfect capital mobility.
  - (d) none of the above.
4. A given increase in government spending is more effective at increasing output in a country that (B. in both A and C, the exchange rate will increase and partly offset the expansionary fiscal policy. D is precisely the contrary to what you need to boost the economy, i.e. small export sensitivity to E.)
  - (a) is very open to trade with a flexible exchange rate.
  - (b) is closed to trade.
  - (c) has a flexible exchange rate.
  - (d) has a large sensitivity of exports with respect to exchange rate.
5. The primary motivation for joining a currency union is (C. That should be clear.)
  - (a) to allow complete freedom in the realm of monetary policy.
  - (b) to prevent real appreciation and loss of export competitiveness.
  - (c) to preserve nominal exchange rate stability.
  - (d) none of the above.

6. Suppose that two countries share identical levels of technology, depreciation rate and savings rate. Populations in both countries do not change over time. According to the Solow model, which of the following statements on the growth rate of output is true? (A. This comes from the concavity of the investment curve, which in turn comes from the concavity of the production function.)
- (a) the country with the smaller level of output per worker will grow more rapidly than the country with the greater level of output per worker.
  - (b) the country with the greater level of output per worker will grow more rapidly than the country with the smaller level of output per worker.
  - (c) both countries necessarily have the same growth rates of output.
  - (d) none of the above.
7. Consider a standard Solow model. If  $s^*$  is the savings rate given by the Golden Rule, and the current savings rate  $s > s^*$ , which of the following is NOT true? (C and B. C is clearly not true:  $k^* = \left(\frac{s}{\delta}\right)^{1/(1-\alpha)}$  so increasing savings rate increases capital per worker in the steady state. B is actually true but we think its proof is too hard and you are not supposed to know that. Hence both answers are treated as correct.)
- (a) An increase in the current savings rate necessarily decreases consumption in the steady state.
  - (b) An increase in the current savings rate necessarily decreases consumption in all future periods
  - (c) An increase in the current savings rate necessarily decreases capital per worker in the steady state.
  - (d) An increase in the current savings rate necessarily increases output per worker in the next period.
8. Consider the following production function with only one factor of production, capital:  $Y = F(K) = AK$ . This production function has which of the following features: (B. See your textbook for the definitions.)
- (a) Constant returns to scale (CRS) and diminishing marginal returns (DMR) in the factor of production.
  - (b) CRS but not DMR.
  - (c) DMR but not CRS.
  - (d) Neither CRS nor DMR.
9. Which of the following best explains the “J-Curve” pattern of net exports adjustment after an exchange rate depreciation? (D. Because prices adjust rapidly, the fact that imports become more costly and exports cheaper means in the very short run, trade balance deteriorates. It is only after quantities are adjusted that net export goes up (assuming the Marshall-Lerner condition holds).)
- (a) Consumers wait to see whether the Marshall-Lerner conditions hold before adjusting their buying patterns.
  - (b) The depreciation lowers domestic interest rates, which increases domestic consumption and investment.
  - (c) Fiscal policymakers fear a “sudden stop” and lower taxes.
  - (d) Prices adjust rapidly after to exchange rate movements, while quantities adjust with a lag.

10. Consider a country where output is higher than its natural level and net exports are zero. Which combination of policies might help this economy to reduce output to its natural rate without creating a trade imbalance? (B. You want to avoid affecting the interest rate thus the exchange rate (ignoring to a first order approximation the effect of output on net export). B is the only choice that could get you there.)
- (a) Contractionary fiscal policy and expansionary monetary policy.
  - (b) Contractionary fiscal policy and contractionary monetary policy.
  - (c) Expansionary fiscal policy and contractionary monetary policy.
  - (d) Expansionary fiscal policy and monetary union with a large neighboring country.
11. Spain and France are in a currency union. For many years the yields on 10-year government bonds of the Spanish and French governments were virtually the same. But over the last two years, the Spanish yields are 2 to 4 percentage points higher. This most likely reflects which of the following causes? (B. Read the newspapers!)
- (a) Higher inflation expectations in Spain.
  - (b) A higher risk of default in Spain.
  - (c) A higher real natural rate of interest in Spain.
  - (d) A higher natural rate of unemployment in Spain.
12. SU is a country with a flexible exchange rate regime that faces a serious and persistent current account deficit. Authorities in SU would like to implement a policy mix that would correct this imbalance without materially changing aggregate demand. Which of the following combinations of policies should they consider? (D. You want to lower the interest rate thus the exchange rate while maintaining output fixed(ignoring to a first order approximation the effect of output on net export).)
- (a) Expansionary fiscal and expansionary monetary policy.
  - (b) Expansionary fiscal and contractionary monetary policy.
  - (c) Contractionary fiscal and contractionary monetary policy.
  - (d) Contractionary fiscal and expansionary monetary policy.
13. The current exchange rate between the US dollar and the Euro is such that  $1 \text{ euro} = 1.30 \text{ dollars}$ . Assume that it is expected that in one year,  $1 \text{ euro}$  will be worth  $1.2 \text{ dollars}$ . Inflation in the US is supposed to be  $\pi^{US} = 4\%$  and in Europe it is supposed to be  $\pi^E = 2\%$ . In what follows, consider the exchange rate from the US perspective (i.e. the US is the home country). Which of the following statements is true? (C.  $E$  is at  $\frac{1}{1.3}$  and will become  $\frac{1}{1.2}$  which is an appreciation. Inflation is higher in the US than in the UK so  $\varepsilon$  becomes even higher.)
- (a) The nominal exchange rate is expected to depreciate, and the real exchange rate is expected to depreciate by a greater percentage than the nominal exchange rate.
  - (b) The nominal exchange rate is expected to depreciate, and the real exchange rate is expected to depreciate by a lesser percentage than the nominal exchange rate.
  - (c) The nominal exchange rate is expected to appreciate, and the real exchange rate is expected to appreciate by a greater percentage than the nominal exchange rate.

- (d) The nominal exchange rate is expected to appreciate, and the real exchange rate is expected to appreciate by a lesser percentage than the nominal exchange rate.

## Question 2: Flexible Exchange Rates [30 points]

Suppose that an open economy is described by the following equations:

$$\begin{aligned} Y &= C(Y - T) + I(Y, i) + G + NX(Y, Y^*, E) \\ M/P &= YL(i) \\ i &= i^* - \frac{E^e - E}{E} \end{aligned}$$

The economy has a flexible nominal exchange rate. All relationships are as discussed in class and initially  $E^e = E$ .

1. Draw the IS and LM curves and identify whether they are steeper, flatter than or have the same slope as their closed economy equivalents. (4 points)

Solution. The IS curve is flatter because now an increase in  $i$  would also push up the nominal exchange rate, which leads to a decrease in net exports assuming the Marshall-Lerner condition. This reduces the amount that output has to adjust.

Mathematically, one can show that

$$\frac{di}{dY} = \frac{1 - C'(Y - T) - I_Y(Y, i) - NX_Y}{I_i(Y, i) + NX_E \frac{dE}{di}},$$

where the subscripts are for partial derivatives. Assume that the effect of output on net exports,  $NX_Y$ , is of second order (which is empirically valid). Since net exports depend positively on nominal exchange rate,  $NX_E < 0$ . From the UIP condition,  $\frac{dE}{di} > 0$ . The denominator is therefore larger in absolute value so the slope is flatter.

2. Draw and explain the UIP relationship. (3 points)

Solution. It's an increasing relationship between  $i$  and  $E$ . The UIP is an implication of no-arbitrage under perfect capital mobility. Namely, the rates of return in saving should be the same if it's done in the domestic currency or in the foreign currency.

3. Suppose that there is a fiscal expansion that increases  $G$ , leaving  $T$  unchanged. Graph the effects of this policy on the IS, LM and the UIP curves. What happens to  $C$ ,  $I$  and  $NX$ ? (7 points)

Solution. The LM curve doesn't shift. The IS would shift to the right, which leads to an increase in the interest rate. The UIP doesn't shift, but the increase in  $i$  would translate into an appreciation. Finally, the appreciation would lead to a lower level of net export, which shifts the IS curve back a bit, but not enough to offset the initial rightward shift.

In the new equilibrium, output increases, interest rate and nominal exchange rate increase. Therefore, consumption would go up. Investment is ambiguous and net exports would go down.

4. Can policymakers reduce the nominal interest rate while leaving output and net exports unchanged? Explain your answer with words or a graph. (4 points)

Solution. No. Since net exports are a function of output, foreign output and the nominal exchange rate, with a given level of foreign output, if output and net exports do not change, the nominal exchange rate has to stay the same. From the UIP condition, this implies that the nominal interest rate is the same, too.

5. Suppose that there is a decrease in foreign output,  $Y^*$ . Using a graph and words, explain how this shock will affect the domestic economy. How would your answer change if the economy had a fixed exchange rate? (7 points)

Solution. Under flexible exchange rate, a decrease in  $Y^*$  would lower net exports, which amounts to a leftward shift of the IS curve. That will in turn lead to a decrease in the equilibrium interest rate and output. The decrease in the interest rate moves along the UIP curve, implying a nominal depreciation, which partly offsets the original leftward shift of the IS curve (still via the net exports channel). The total result is a lowered output, interest rate and a depreciation.

Under fixed exchange rate, the monetary authority has to balance the left shift of the IS curve with a contractionary monetary policy to maintain the interest rate unchanged. The nominal exchange rate cannot depreciate to alleviate the decrease in output resulting from IS shifted leftward. Both effects imply that the decrease in output will be larger in this situation.

6. Suppose now that the economy forms a currency union with its trading partners so that  $E$  and  $E^e$  are fixed and equal to each other. Describe one macroeconomic policy that could help this country to reduce its trade deficit with certainty. Identify the implications of this policy for C, I and Y. (5 points)

Solution. Note that you cannot devalue in a currency union. One could adopt a contractionary fiscal. Money will go out of the country because of the resulting interest rate differential, which amounts to be equivalent to a contractionary monetary policy. The net effect will be a lowered output, while the interest rate and the exchange rate stay the same. This would imply an increase in net export thus a reduction of the trade deficit.

### Question 3: The Solow Model with Population Growth [31 points]

Consider the following growth model without technological change.

$$Y = F(K, N) = K^\alpha N^{1-\alpha}.$$

Population grows at constant rates  $g_N$ . The savings rate is  $s$  and stays constant. Capital depreciates at a constant rate,  $\delta$ . All parameters are positive.

1. Rewrite the production function in per worker terms. (3 points)

Solution. Divide both sides of the production function by  $N$ , we get

$$y = \frac{Y}{N} = k^\alpha.$$

2. Denote by  $k_t$  capital per worker. Show that

$$k_{t+1} = \frac{1}{1 + g_N} [sk_t^\alpha + (1 - \delta)k_t]. \quad (3 \text{ points})$$

Solution. The law of motion for capital is

$$K_{t+1} - K_t = sY_t - \delta K_t.$$

Divide both sides by  $N_t$ , we get

$$\frac{K_{t+1}}{N_t} - k_t = sy_t - \delta k_t.$$

Using the result of the previous equation and re-arranging:

$$\frac{N_{t+1}}{N_t} k_{t+1} = sk_t^\alpha + (1 - \delta) k_t,$$

which leads directly to the result as  $\frac{N_{t+1}}{N_t} = 1 + g_N$ .

3. In what follows, we use the result that applying approximation techniques, the equation in part (2) can be re-written as

$$k_{t+1} - k_t = \frac{1}{1 + g_N} [sk_t^\alpha - (\delta + g_N)k_t].$$

Determine the steady state level of capital per worker. (2 points)

Solution. By definition, in the steady-state we have  $k_{t+1} = k_t = k^*$ . So

$$sk^{*\alpha} - (\delta + g_N)k^* = 0,$$

which gives

$$k^* = \left( \frac{s}{\delta + g_N} \right)^{\frac{1}{1-\alpha}}.$$

4. Draw the Solow diagram. Suppose  $k_0$  is below the steady state level, draw the evolution of  $k_t$  over time. (5 points)

Solution. See your textbook. Capital per worker increases all the way to the steady state.

5. Assume that capital per worker stays at its steady state level. Write down output,  $Y_t$ , as a function of the initial population,  $N_0$ . Determine the growth rate of output. (4 points)

Solution.

$$Y_t = N_t y_t = N_0 (k^*)^\alpha e^{g_N t}.$$

The growth rate of output is  $g_N$ .

6. Write down consumption per worker,  $c_t$ , as a function of  $k_t$  and the savings rate. Determine the Golden Rule level of the savings rate in this economy. (6 points)

Solution.

$$c_t = (1 - s) k_t^\alpha.$$

At the steady state, we have

$$c^* = (1 - s) \left( \frac{s}{\delta + g_N} \right)^{\frac{\alpha}{1-\alpha}}.$$

Taking log:

$$\ln c^* = -\frac{\alpha}{1-\alpha} \ln (\delta + g_N) + \ln (1 - s) + \frac{\alpha}{1-\alpha} \ln s.$$

Differentiating it w.r.t.  $s$  gives the following first order condition,

$$0 = -\frac{1}{1-s} + \frac{\alpha}{1-\alpha} \frac{1}{s}.$$

So  $s = \alpha$ .

7. Using a Solow diagram, show how the accumulation of capital per worker would change if there were an increase in the population growth rate,  $g_N$ . Provide the intuition. In another diagram, draw the evolution of consumption per worker over time after this change. (8 points)

Solution. The increase in  $g_N$  would shift up the required investment curve, resulting in a lower level of  $k_t$  and  $y_t$  in the steady state. Intuitively, the original level of investment is no longer sufficient to keep up with the growing population so capital per worker would fall.

Since  $c_t = (1 - s) y_t$ , it suffices to study the evolution of  $y_t$ .  $y_t = k_t^\alpha$  was at its steady state level and will change to its new steady state level which is lower. Hence, the evolution of consumption per worker decreases from  $(1 - s) (k^*)^\alpha$  to  $(1 - s) (k'^*)^\alpha$ . Make sure that the rate of change becomes slower and slower in your graph.

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