# 14.02 Principles of Macroeconomics
# Problem Set 3
# Solutions
# Fall 2004

## Part I.  True/False/Uncertain
Justify your answer with a short argument.

1.  Suppose interest rates for a one-period deposit are 5% in the US (the home country) and 2% in Canada. Assume that the risk premium in Canada is the same as in the US. This implies that the investor should invest in the US.

    ***Uncertain.*** *The answer depends on the expected depreciation of the dollar. According to the uncovered interest rate parity, if* $i_t > i_t^* + \dfrac{E_{t+1}^e - E_t}{E_t}$, *then the investor should put her money into the US. If, however,* $i_t < i_t^* + \dfrac{E_{t+1}^e - E_t}{E_t}$, *then the investor should put her money into Canada. Here, i=5% and i\*=2%. Therefore, if the dollar is expected to depreciate by more than 3%[1] during the next period, the investor should invest in Canada. If it's expected to depreciate by less, then she should invest in the US. (See page 388.)*

2.  Dan (a US citizen) pays $160,000 in cash to a US Mercedes Benz dealer for a 2005 SL500 Roadster. The dealer then pays $150,000 to Mercedes Benz of Germany. Mercedes deposits $150,000 in its US bank account. This transaction has increased the US capital account surplus. (Assume there is no statistical discrepancy.)

    ***True.*** *Mercedes cars are US imports. Therefore, Dan's purchase is recorded as -150,000 in the US current account. Why not $160,000? It is because the dealer is also a US agent. Thus, the $10,000 that the dealer keeps after the transaction does not affect the current account. On the other hand, +150,000 is recorded in the US capital account. (Mercedes has increased its holding of US currency.)*

3.  Following a real depreciation, the trade balance improves.

    ***Uncertain.*** *We need to distinguish between what happens in the short-run vs. what happens in the long-run. If we look at the effects of a real depreciation over time, we see that it initially increases the trade deficit, because ε rises, but neither IM nor X changes right away. Thus, in the short run, the trade balance actually worsens. As time passes, however, exports begin to increase and imports decreases, reducing the trade deficit. (Recall that the trade balance or net exports is NX = X(Y\*,ε) – εIM(Y,ε).) The real exchange rate, ε, enters the right-hand side of this expression in three places. As a result of an increase in ε (a real depreciation), exports, X, increase; imports, IM, decrease; and the relative price of foreign goods, ε, increases. Thus, for the trade balance to improve following a real depreciation exports must increase enough and imports must decrease enough to compensate for the*

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[1] In this answer, we have taken the approximate version of the uncovered interest rate parity. (See page 388 for the way to arrive at the approximation.)  If you were to use the exact version, this number would be 2.94%.

*increase in the price of imports. The condition under which a real depreciation leads to an increase in net exports is known as the Marshall-Lerner condition. (Note, however, that this condition is satisfied in reality.) (See page 406.) Therefore, eventually the trade balance improves beyond its initial level. This adjustment is referred to as the J-curve. (See pages 408-410)*

4. Consider the Mundell-Flemming model of a small open economy. If the government increases taxes, the exchange rate will depreciate. (Assume taxes are lump-sum, not proportional.) In order to bring the exchange rate down to its original level, the Fed should expand the money supply.

   **False.** *The first part of the statement is true: by increasing taxes, the government enacts contractionary fiscal policy. This shifts the IS curve to the left, which implies that the interest rate declines. According to the interest rate parity condition, the exchange rate increases (depreciates). (See page 425.)*
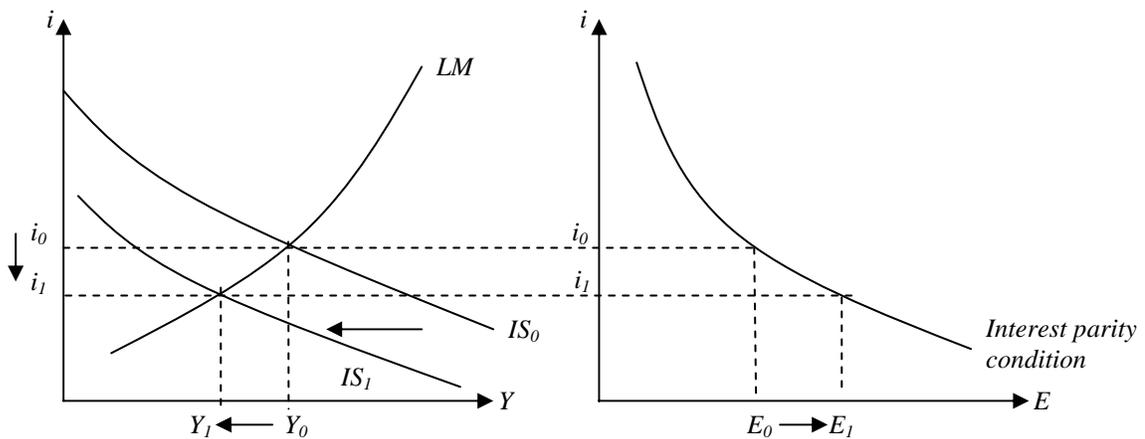


Fig. 1

*However, the last sentence is false. Expansionary monetary policy, that shifts the LM curve down and to the right, decreases the interest rate even further, leading to an even larger depreciation of the exchange rate.*
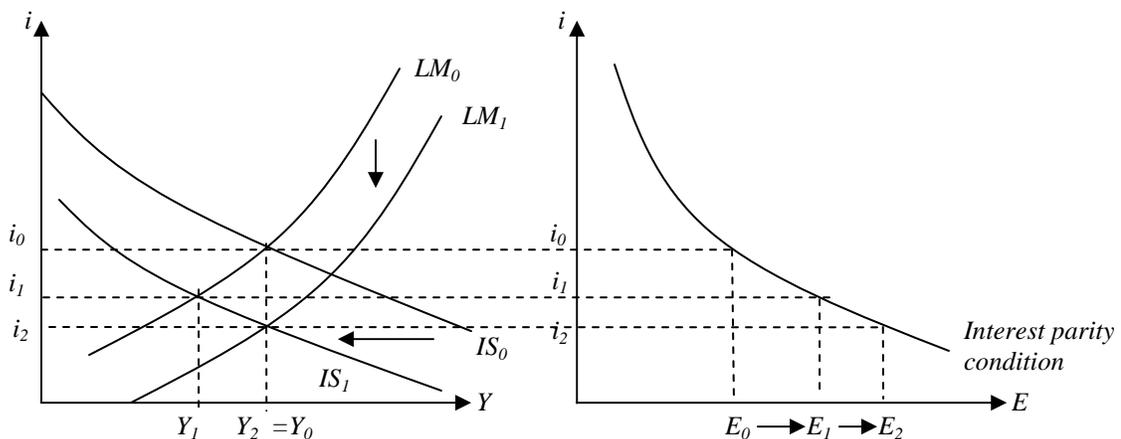


Fig. 2

5. Compared to the closed economy, a given increase in government spending will cause a larger increase in output in the open economy with flexible exchange rates. (Assume that the two economies start in equilibrium.)

   *False. An increase in government spending will, indeed, cause an increase in output in the open economy. However, because the multiplier is smaller in the open economy, this increase in output will be smaller than in closed economy. This is because imports are an increasing function of domestic output. As income rises due to the increase in government spending, consumers buy more imports, as well as more domestic goods, and therefore some of the positive effect on domestic output is lost. (See page 401 and answer to Part II, question 6.) Another reason for why the increase in output will be smaller comes from the exchange rate. An increase in government spending raises the interest rate and leads to an appreciation, which lowers net exports and offsets part of the positive effect on Y (see page 424).*

6. In an open economy, fiscal policy is more effective than (or at least as effective as) monetary policy (in terms of changing output).

   *False. In an open economy with fixed exchange rates, fiscal policy is, indeed, more effective than monetary policy. In fact, monetary policy has absolutely no effect. (See pages 429-430.) However, in an open economy with flexible exchange rates, monetary policy should actually be more effective, since there is an additional channel through which it can affect output. Consider monetary vs. fiscal contraction. If the central bank decreases money supply, domestic interest rates increase and output decreases. But as the interest rates rises relative to the interest in the rest of the world, more investment comes in from abroad (because the return on it is higher at home), and this increases the demand for the home currency. Thus, it will appreciate making the domestic goods relatively more expensive than in the rest of the world, which will lower exports and increase imports. This will decrease US output even more. On the other hand, fiscal policy is less effective in this case. Suppose the government decreases spending (or increases taxes). People will consume less, but part of this will be manifested in lower imports. So, part of the contraction will be felt abroad.*

## Part II.  The Goods Market in a Two-Country Model

Consider two open economies, Blanchardostan and the Republic of Caballeria. Assume that these countries only trade with each other. Variables with subscript B and variables with subscript C correspond to Blanchardostan and the Republic of Caballeria, respectively. The two economies are characterized by the following set of equations:

$C_i = c_{0i} + c_{1i}(Y_i - T_i)$ where $i = B$ or $C$ (B for Blanchardostan and C for Caballeria)
$I_i = \bar{I}$
$G_i = \bar{G}_i$
$T_i = t_i Y_i$
$IM_i = im_{0i} + im_{1i} Y_i$
$\varepsilon = 1$

1. Derive the expression for equilibrium output $Y_B$ as a function of $G_B$ and $Y_C$ (Note that $Y_C$ is exogenous from the perspective of Blanchardostan.) Similarly, derive the expression for $Y_C$.

*Note that $X_B = \varepsilon IM_C = \varepsilon(im_{0C} + im_{1C}Y_C) = im_{0C} + im_{1C}Y_C$ (since $\varepsilon=1$).*

$Y_B = C_B + I_B + G_B + X_B - \varepsilon IM_B$

$Y_B = c_{0B} + c_{1B}(Y_B - t_BY_B) + \overline{I} + \overline{G}_B + im_{0C} + im_{1C}Y_C - im_{0B} - im_{1B}Y_B$

$Y_B (1 - c_{1B}(1-t_B) + im_{1B}) = c_{0B} + \overline{I} + \overline{G}_B + im_{0C} + im_{1C}Y_C - im_{0B}$

$$Y_B = \frac{1}{1 - c_{1B}(1-t_B) + im_{1B}} (c_{0B} + \overline{I} + \overline{G}_B + im_{0C} + im_{1C}Y_C - im_{0B})$$

*You can find similarly that*

$$Y_C = \frac{1}{1 - c_{1C}(1-t_C) + im_{1C}} (c_{0C} + \overline{I} + \overline{G}_C + im_{0B} + im_{1B}Y_B - im_{0C})$$

2. Let

$c_{0B} = c_{0C} = 200$
$c_{1B} = c_{1C} = 0.5$
$\overline{I} = 250$
$G_B = 114$
$G_C = 120$
$t_B = t_C = 0.4$
$im_{0B} = im_{0C} = 40$
$im_{1B} = 0.05$
$im_{1C} = 0.3$
$\varepsilon = 1$
All figures are in millions of US dollars.

Calculate the equilibrium levels of output in the two countries.

$$Y_B = \frac{1}{1 - 0.5(1-0.4) + 0.05} (200+250+114+40+0.3Y_C - 40)$$
$Y_B = 4/3\ (564 + 0.3Y_C)$
$Y_B = 752 + 0.4Y_C$

$$Y_C = \frac{1}{1 - 0.5(1-0.4) + 0.3} (200 + 250+120+40+0.05Y_B - 40)$$
$Y_C = 570 + 0.05Y_B$
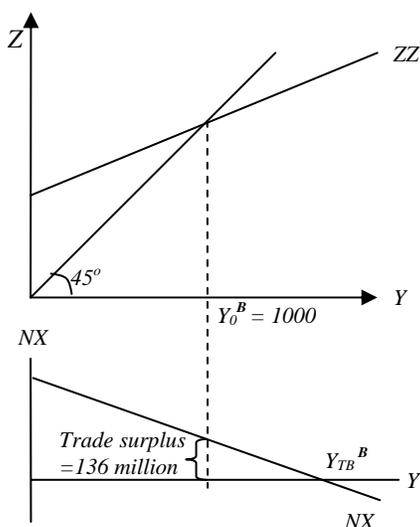
$Y_B = 752 + 0.4(570 + 0.05Y_B)$

$Y_B = 1000$
$Y_C = 620$

3. Calculate the trade balance (i.e. the current account) for each country. Is there a trade/current account deficit or surplus in Blanchardostan? In the Republic of Caballeria?

$X_B - \varepsilon IM_B = X_B - IM_B = IM_C - IM_B = im_{0C} + im_{1C}Y_C - im_{0B} - im_{1B}Y_B = 0.3(620) - 0.05(1000) = 136$

*So, Blanchardostan has a trade surplus of 136 million. Caballeria has a trade deficit of 136 million.*

4. Draw a diagram to show equilibrium output and net exports for Blanchardostan. Label the equilibrium output $Y_0{}^B$ and the output at which there is trade balance, $Y_{TB}{}^B$.



5. Suppose the government of Blanchardostan wants to increase government spending by 147 million. What would be the new equilibrium output levels in the two economies? What is the government spending multiplier in Blanchardostan?

*Note that we cannot simply use the formula for the open-economy multiplier here, because the countries' exports are not exogenously given.*

$Y_B = \dfrac{1}{1 - 0.5(1 - 0.4) + 0.05}(200 + 250 + 114 + 147 + 40 + 0.3Y_C - 40)$

$Y_B = 4/3 \ (711 + 0.3Y_C)$
$Y_B = 948 + 0.4Y_C$
$Y_C = 570 + 0.05Y_B$
$Y_B = 948 + 0.4(570 + 0.05Y_B)$

$Y_B = 1200$
$Y_C = 630$

*Let $m_B^{End.X}$ represent the government spending multiplier in Blanchardostan, where "End. X" represents "endogenous exports."*

$m_B^{End.X} = \dfrac{\Delta Y}{\Delta G} = \dfrac{200}{147} \approx 1.36$

*Note that the increase in government spending increases Blanchardostan's output. Because of this, its imports increase as well. But since Blanchardostan's imports are exports of the other country, this expansionary fiscal policy also has positive effects on the output of the Republic of Caballeria.*

*An alternative and more explicit way of finding the multiplier in this open economy is the following:*

$Y_B = 4/3$ *(constant + $G_B$ + 0.3$Y_C$) and we know that $Y_C = 570 + 0.05Y_B$*
*Thus plugging $Y_C$ into $Y_B$, we get that:*

$$Y_B = 4/3(const + G_B + 0.3 * const + 0.3 * 0.05 Y_B)$$
$$\Leftrightarrow Y_B(1 - 4/3 * 0.05) = 4/3 * G_B + const$$
$$\Leftrightarrow Y_B = \frac{1}{1 - 4/3 * 0.3 * 0.05}(4/3 * G_B + const)$$
$$\Rightarrow \frac{\partial Y_B}{\partial G_B} = \frac{4/3}{1 - 4/3 * 0.05 * 0.3} = \frac{4/3}{1 - 4/3 * 0.05 * 3/10} = \frac{4/3}{0.98} = 1.359$$

*So, notice that this is our exogenous multiplier (that we find in part 6) times a multiplier which comes from the fact that exports are endogenous (intuitively, this multiplier is $\frac{1}{1 - im_{1B} im_{1C}}$.)*

6. Assume that exports are exogenously given from now on. What is the open economy government spending multiplier in Blanchardostan? Suppose the two economies decide to close. What is the government spending multiplier in Blanchardostan now, assuming all the other figures remained the same? Compare the different multipliers that you found in parts 5 and 6.

*In an open economy with exogenously given exports:*

$$\Delta Y = \frac{1}{1 - c_1(1-t) + im_1} \Delta G \Rightarrow m_B^{Exog.X} = \frac{1}{1 - c_1(1-t) + im_1} = \frac{1}{1 - 0.5(1 - 0.4) + 0.05} = 1.3\bar{3}$$

*where "Exog. X" represents "exogenous exports." (See page 415.)*

*In a closed economy:*

$$\Delta Y = \frac{1}{1 - c_1(1-t)} \Delta G \Rightarrow m_B^{Closed} = \frac{1}{1 - c_1(1-t)} = \frac{1}{1 - 0.5(1 - 0.4)} \approx 1.43$$

*The closed economy multiplier is the largest, because the effect of an increase in government spending is only felt at home. (Imports do not increase.) In an open economy, part of the effect of the fiscal expansion is felt in the foreign country, because domestic imports rise, and therefore domestic output rises by less than it would in a closed economy. That's the end of the story if exports are fixed, as we have assumed in part 6. However, if exports are not given exogenously, (part 5), as the foreign economy (i.e. Caballeria) expands (due to the rise of its exports), it begins to demand more of Blanchardostan's exports. That's why the multiplier is*

*larger in this case and the effect of expansionary fiscal policy is greater. In our case, this feedback mechanism is given by the difference between $m_B^{End.X}$ and $m_B^{Exog.X}$. So, higher government spending in Blanchardostan increases its output and imports. Since Blanchardostan's imports equal Caballeria's exports, this fiscal expansion also increases Caballeria's output. But this means it imports more from Blanchardostan, and so on.*
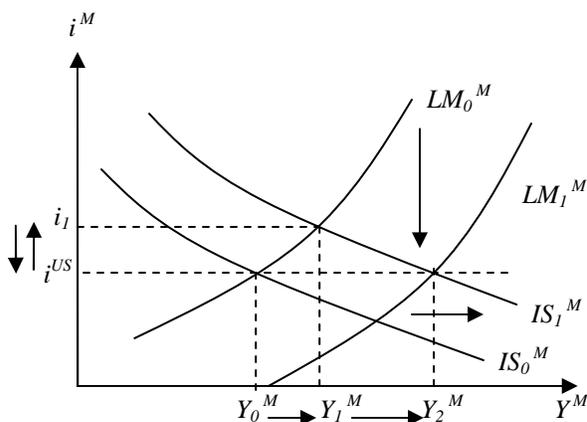
*When is it okay to assume that exports are exogenous, and when are they endogenously determined? Typically, we assume that exports are exogenous when we deal with small open economies. Intuitively, it makes sense to assume that Luxembourg's policy choices do not affect the US economy, for example. However, if we are analyzing two large economies, such as the US and the UK, we need to account for endogeneity of exports.*

## Part III. Fixed Exchange Rates

Consider a small open economy (call it Mundellia) which obeys our Mundell-Flemming model and is the domestic country. Assume that it has a credible fixed exchange rate regime and starts out in equilibrium. Assume that for Mundellia, US represents "the rest of the world."

1. Use intuition and diagrams to explain what happens in Mundellia as a result of the following changes.

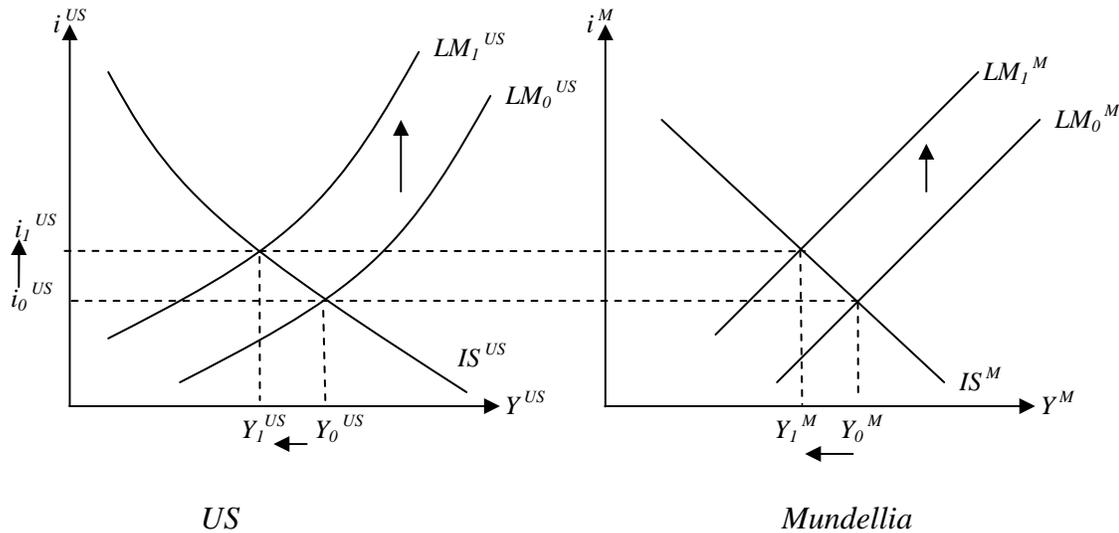   a. There is an increase in consumer confidence in Mundellia.

   *An increase in consumer confidence implies that $c_0$ increases, which leads to a rise in consumption. This shifts out the IS curve from $IS_0^M$ to $IS_1^M$. If exchange rates were flexible, this would be the end of it, and output would settle at $Y_1^M$ and there would an appreciation of the exchange rate in Mundellia. But under the fixed regime, the central bank cannot allow the currency to appreciate. As the increase in output leads to an increase in the demand for Mundellian money, the central bank must accommodate this increase demand for money by increasing the money supply. (What if it didn't increase the money supply? Then, we would have $i > i^{US}$ and there would be infinite capital inflows. The fixed exchange rate would not be sustainable.) Thus, the LM curve will shift down and to the right, so that the interest rate and, therefore, the exchange rate do not change. The equilibrium output is $Y_2^M$. So, under fixed exchange rates, fiscal policy is more powerful than it is under flexible exchange rates. (See page 429.)*

   b. The US Fed decreases money supply.

*Note that in Mundellia, interest rates are fixed at the US level ($i = i^{US}$), because the exchange rate is pegged to the dollar.*



*As the US Fed decreases money supply, US interest rates increase, because the LM curve shifts up and to the left. Through the uncovered interest rate parity, the dollar appreciates. But, because Mundellian currency is pegged to the dollar ($E^M = E^{US}$), it also must appreciate and the interest rates in Mundellia rise as well. The central bank must accommodate this increase. (If the central bank didn't decrease money supply, we would have $i < i^{US}$ and there would be infinite capital outflows. Again, as in the previous part, the fixed exchange rate would not be sustainable.) Thus, the LM shifts up and to the left in Mundellia, bringing output down from $Y_0^M$ to $Y_1^M$.*

2. Discuss the pros (if any) and cons (if any) of the Mundellian fixed exchange rate regime. (Use intuition and your analysis in part 1 to answer this question.)

*We know that under a fixed exchange rate and perfect capital mobility, the Mundellian interest rate must equal to the US interest rate. This condition implies that under fixed exchange rates, the central bank gives up monetary policy as a policy instrument. (See pages 428-429.) We have seen from part 1, that all the Mundellian central bank can do is be a passive accommodator, never a policymaker. This can be very dangerous. In part 1b, the Mundellian interest rate increased following rising interest rates in the US, which brought Mundellian output down. We can imagine a scenario, where the US Fed enacts contractionary monetary policy to cool down a booming economy, which is an appropriate response. However, this also increases interest rates and decreases output in Mundellia, where the economy is not necessarily booming. The increase in interest rates has an additional adverse effect of lowering Mundellian investment. Thus, if the US and Mundellian economies do not have similar "boom-bust" cycles, pegging the exchange rate to the dollar may be detrimental.*

*On the other hand, as we have seen in part 1a, Mundellian fiscal policy is more effective under a fixed exchange rate system. On the surface this seems like a pro for pegging the exchange rate to the dollar – fiscal expansion increases output by more than under flexible exchange rates (all else equal) because it triggers monetary accommodation.*

*However, one policy instrument is not enough. The large impact on output due to expansionary fiscal policy comes at a cost of a larger trade deficit. (See page 430.)*

*So far, we have focused primarily on the negative side of a fixed exchange rate system. To stay within the scope of Chapter 20, we will only mention some of the pros. If the Mundellian economy closely followed the US economy in terms of its recessions and booms, it would not suffer that much from inability to enact monetary policy. Essentially, it would surrender that role to the US Fed. What would it gain? It would gain credibility that is associated with the US. Political considerations play a major role in a country's decision whether or not to adopt a fixed exchange rate regime. To learn more about the pros and cons of a fixed exchange rate regime, refer to Chapter 21.*