

PROBLEM SET 7 Solutions
14.02 Principles of Macroeconomics
May 6, 2005

I. Answer each as True, False, or Uncertain, providing some explanation for your choice.

1. A real depreciation always improves the trade balance.

False. In theory, if the Marshall-Lerner condition does not hold, a real depreciation can lead to a decrease in net exports. In reality, the effect of the depreciation is reflected much more in prices than in quantity initially. Thus, the trade balance deteriorates first and then improves gradually. (See the J-Curve section in Chapter 19)

2. An increase in exports (due for example to an increase in foreign output) increases imports.

True. An increase in foreign demand for domestic goods increases exports directly, which leads to a higher level of domestic output. Higher domestic income increases imports, as the latter depends on domestic output positively. Note that the increase in exports is still higher than the increase in imports, and the trade balance still improves.

3. Governments should avoid trade deficits as they always lead to an outflow of foreign capital.

False. All else equal, trade deficit implies a lower current account. We know that a lower current account means a higher capital account, which means an inflow of foreign capital, instead of an outflow of foreign capital. Governments dislike trade deficits because of an increase in interest payments due to the increase in foreign holdings of domestic financial assets.

4. If the domestic nominal interest rate and the expected exchange rate are both fixed, and the domestic and foreign nominal interest rates are initially equal, then an increase in the foreign interest rate will create expectations of an appreciation in the domestic currency.

TRUE - The proposition follows simply from the interest parity condition. Before the change in i^* , $E = E^e$. An increase in i^* must, given i and E^e , reduce E (otherwise the interest parity condition would be violated). But this means $E < E^e$, implying an expected appreciation tomorrow.

5. In an open economy, monetary policy affects the demand for domestic goods through two channels instead of the usual one.

TRUE - The usual channel is through investment (recall that monetary policy works by changing the interest rate). In an open economy, the additional channel is through the interest parity condition, thereon through the exchange rate, and thereon through net exports to output in the goods market.

6. If capital is not perfectly mobile, the policy maker may be able to control both the money supply and the exchange rate.

TRUE - The Mundell-Fleming model shows that with perfect capital mobility, the policy maker can only control one of the two, money supply OR the exchange rate, but not both. Conversely, as shown in the Appendix to Ch. 20, introducing some restrictions on the mobility of capital frees the policy maker from this bind.

II. Policy Mix (Chapter 19)

Consider the following specifications of an open economy:

$$C = c_0 + c_1(Y - T)$$

$$I = b_1Y - b_2i$$

$$G = G_0$$

$$T = T_0$$

$$X = x_1Y^* - x_2\epsilon$$

$$IM = q_1Y + q_2\epsilon$$

where $c_0, c_1, b_1, b_2, G_0, T_0, x_1, x_2, q_1, q_2$ are all positive constants. Y^* is foreign output/income and ϵ is the real exchange rate (the price of domestic goods in terms of foreign goods)

1. Express the equilibrium domestic output in the form of $\mu A(T_0, G_0, i, Y^*, \epsilon)$, where $A(T_0, G_0, i, Y^*, \epsilon)$ is the autonomous spending, and μ is the multiplier in the domestic goods market. Express μ in terms of c_1, b_1 and q_1 ? (Assume that the condition for μ being positive holds from now on.)

Ans:

Total demand for domestic goods - Z:

$$\begin{aligned} Z &= C + I + G - \frac{IM}{\epsilon} + X \\ &= c_0 + c_1(Y - T_0) + b_1Y - b_2i + G_0 - \frac{1}{\epsilon}(q_1Y + q_2\epsilon) + x_1Y^* - x_2\epsilon \end{aligned}$$

Goods Market Equilibrium:

$$\begin{aligned} Y &= c_0 + c_1(Y - T_0) + b_1Y - b_2i + G_0 - \frac{1}{\epsilon}(q_1Y + q_2\epsilon) + x_1Y^* - x_2\epsilon \\ &= \frac{1}{1 - c_1 - b_1 + q_1/\epsilon} A(T, G, i, Y^*, \epsilon) \end{aligned}$$

where $A(T_0, G_0, i, Y^*, \epsilon) = (c_0 - q_2) - c_1T_0 - b_2i + G_0 + x_1Y^* - x_2\epsilon$. The multiplier is $\frac{1}{1 - c_1 - b_1 + q_1/\epsilon}$.

2. What is the interpretation of q_1 ? How does a higher q_1 affect the multiplier? Explain.

Ans:

q_1 measures how much an economy relies on imports. If q_1 is higher, it imports more from abroad for any increase in Y . q_1 is usually higher for small

open economies, eg. Belgium. A higher q_1 decreases the multiplier more because if the economy relies heavily on imports, a big fraction of any initial increase in income will go to foreign countries, instead of staying inside the economy to generate more output/ income.

3. Derive the condition we need such that a real depreciation leads to an improvement in the trade balance. Explain intuitively why we need this condition.

Ans:

$$\begin{aligned}
 NX &= X - \frac{IM}{\epsilon} \\
 &= x_1 Y^* - x_2 \epsilon - \frac{(q_1 Y + q_2 \epsilon)}{\epsilon} \\
 &= x_1 Y^* - x_2 \epsilon - q_1 Y / \epsilon - q_2 \\
 \frac{\partial NX}{\partial \epsilon} &= -x_2 + \frac{q_1 Y}{\epsilon^2} - \frac{q_1}{\epsilon} \frac{\partial Y}{\partial \epsilon} \tag{1}
 \end{aligned}$$

[Notice that Marshall-Lerner condition is a partial equilibrium condition, which ignores the indirect effect of changes in ϵ on NX through Y (ie. $\frac{\partial Y}{\partial \epsilon} = 0$ in Marshall-Lerner). Here we are asking for the general equilibrium condition, which also considers the indirect effect through Y (ie. $\frac{\partial Y}{\partial \epsilon} \neq 0$).]

From part (1), we can derive $\frac{\partial Y}{\partial \epsilon}$:

$$\begin{aligned}
 \frac{\partial Y}{\partial \epsilon} &= \frac{q_1 / \epsilon^2}{(1 - c_1 - b_1 + q_1 / \epsilon)^2} A(T, G, i, Y^*, \epsilon) + \frac{1}{1 - c_1 - b_1 + q_1 / \epsilon} A_\epsilon(T, G, i, Y^*, \epsilon) \\
 &= \frac{q_1}{(1/\mu)^2 \epsilon^2} A(T, G, i, Y^*, \epsilon) - x_2 \mu \\
 &= \frac{\mu q_1 Y}{\epsilon^2} - x_2 \mu
 \end{aligned}$$

Plug it back to equation 1, we get

$$\begin{aligned}
 \frac{\partial NX}{\partial \epsilon} &= -x_2 + \frac{q_1 Y}{\epsilon^2} - \frac{q_1}{\epsilon} \left(\frac{\mu q_1 Y}{\epsilon^2} - \mu x_2 \right) \\
 &= -x_2 \left(1 - \frac{\mu q_1}{\epsilon} \right) + \frac{q_1 Y}{\epsilon^2} \left(1 - \frac{\mu q_1}{\epsilon} \right)
 \end{aligned}$$

A real depreciation improves the trade balance if

$$\frac{\partial NX}{\partial \epsilon} = -x_2 \left(1 - \frac{\mu q_1}{\epsilon} \right) + \frac{q_1 Y}{\epsilon^2} \left(1 - \frac{\mu q_1}{\epsilon} \right) < 0$$

[If you answered up to this point, you get full credit for this part.]

The required condition becomes:

$$\left\{ \begin{array}{l} \frac{q_1 Y}{\epsilon} < x_2 \epsilon \text{ if } 1 - \frac{\mu q_1}{\epsilon} \geq 0 \\ \frac{q_1 Y}{\epsilon} > x_2 \epsilon \text{ if } 1 - \frac{\mu q_1}{\epsilon} \leq 0 \end{array} \right\}$$

If $1 - \frac{\mu q_1}{\epsilon} \leq 0$, then $\frac{\mu q_1}{\epsilon} \geq 1 \Rightarrow \frac{q_1}{\epsilon} \geq 1 - c_1 - b_1 + q_1/\epsilon \Rightarrow c_1 + b_1 \geq 1$. The last condition violates our usual assumption about the coefficients (We should have given you this!). Consider a closed economy, if $1 \leq c_1 + b_1$, then the multiplier is negative.

With the assumption that $1 \geq c_1 + b_1$, the sufficient condition is

$$\frac{q_1 Y}{\epsilon} < x_2 \epsilon$$

All else equal, if (i) domestic goods are more expensive relative to foreign goods initially (high ϵ); or (ii) a country has a low output (low Y); or (iii) exports are very sensitive to changes in the real exchange rate (high x_2); or (iv) imports are less responsive to changes in domestic output (low q_1), then a real depreciation is more likely to lead to an improvement in the trade balance.

(i) because with a high ϵ , a change in ϵ does not affect IM/ϵ that much but its marginal impact on exports is still $-x_2$. A substantial increase in exports but a small change in imports give us an improvement in the trade balance.

(ii) because if the domestic output is low to start with, the impact on NX through the import channel is small while that through the export channel is still a constant $-x_2$.

(iii) because if x_2 is bigger, the impact on NX through the export channel is bigger.

(iv) because of the same reason for (ii).

4. With the condition you derived in (3), can we be sure that domestic output increases as a result of a real depreciation?

Ans:

Yes. Since ϵ only enters ZZ through imports and exports, if the net export increases as a result of a real depreciation, Y also increases.

The fact that ϵ appears in the multiplier does not affect our answer here.

By setting $\frac{\partial Y}{\partial \epsilon} = \frac{\mu q_1 Y}{\epsilon^2} - x_2 \mu < 0$, and the assumption that $\frac{1}{\mu} = 1 - c_1 - b_1 + q_1/\epsilon > 0$, we get

$$\frac{q_1 Y}{\epsilon} < x_2 \epsilon$$

which is the condition we derived in (3) if $1 - \frac{\mu q_1}{\epsilon} \geq 0$ (ie. $1 \geq c_1 + b_1$).

5. Suppose we start with a situation in which trade is balanced, but output is below its natural level. What can the government do if it wants to increase output but does not want to generate a trade deficit. Derive the required changes in G and ϵ (Assume that both ∂G and $\partial \epsilon$ are small, so you can use a linear approximation)

Ans:

The government can increase government spending and depreciate the exchange rate at the same time. An increase in government spending and a real depreciation both increase output. Since increasing government spending worsens the trade deficit, the government should make sure that the real depreciation is enough to offset the undesired trade deficit.

Thus, we have

$$\begin{aligned} 0 &= \partial NX = \frac{\partial NX}{\partial Y} \frac{\partial Y}{\partial G} \partial G + \frac{\partial NX}{\partial \epsilon} \partial \epsilon \\ &= \left(-\frac{q_1}{\epsilon}\right) \mu \partial G + \left[-x_2 \left(1 - \frac{\mu q_1}{\epsilon}\right) + \frac{q_1 Y}{\epsilon^2} \left(1 - \frac{\mu q_1}{\epsilon}\right)\right] \partial \epsilon \\ &\quad -\frac{\mu q_1}{\epsilon} \partial G = \left(1 - \frac{\mu q_1}{\epsilon}\right) \left(-x_2 + \frac{q_1 Y}{\epsilon^2}\right) \partial \epsilon \end{aligned} \quad (2)$$

The magnitude of $\partial \epsilon$ depends on ∂G . A higher increase in government spending requires a bigger real depreciation to keep the trade balance intact.

Of course, the determination of the required changes depends on how much output the government wants to increase. If ∂Y is the desired quantity, we have the second equation

$$\begin{aligned} \partial Y &= \frac{\partial Y}{\partial G} \partial G + \frac{\partial Y}{\partial \epsilon} \partial \epsilon \\ &= \mu \partial G + \mu \left(Y q_1 / \epsilon^2 - x_2\right) \partial \epsilon \end{aligned} \quad (3)$$

Given ∂Y , equation 2 and 3 pin down the the magnitudes of ∂G and $\partial \epsilon$.

III. IS-LM in an open economy (Chapter 20)

Consider the following situation. A country is running a large trade deficit, and the policy maker wishes to reduce it, while not affecting aggregate output. The exchange rate is flexible, so direct devaluation is not an option. You may assume that the Marshall-Lerner condition is satisfied, that there is no J-curve effect, that the domestic and international prices are fixed and equal, and that the country allows capital to flow in or out without restraint.

1. Describe a mix of fiscal and monetary policies which would do the job.

Ans:

The only mix of policies which would work would be contractionary fiscal policy (IS shifts to the left) and expansionary monetary policy (LM shifts to the right), the two balanced in such a way that aggregate output is not affected (the new IS and LM curves intersect at the same Y as before). The trade deficit would unambiguously improve, since both policies would depreciate the nominal and real exchange rates (since interest rates would decrease). Note that each policy in isolation would also improve the trade deficit, since each would lead to a depreciation of the exchange rate (nominal and real), but there would be unwanted output effects, and so the two must be used simultaneously. It is possible to eliminate every other possible combination of fiscal and monetary policies as follows. Expansionary fiscal and expansionary monetary policies would unambiguously increase output (moreover the effect on the exchange rate would be ambiguous, although it could go in the desired direction). Contractionary fiscal and contractionary monetary policies would unambiguously reduce output (once again, the effect on the exchange rate would be ambiguous although it could go in the right direction). Expansionary fiscal and contractionary monetary policies would keep output fixed, but appreciate the exchange rate unambiguously, and so increase the trade deficit.

2. Which components of aggregate demand are different between the old equilibrium and the new equilibrium (i.e., before and after the policies are enacted)? And in what way?

Ans:

Since the result of policy would be no change in output, there must be components of aggregate demand that would increase to compensate for the decrease in government spending. These components are investment (due to the decline in the interest rate) and net exports (due to the depreciation).

3. Suppose the exchange rate were fixed, but once again direct devaluation is not an option (the point of a fixed exchange rate is precisely that - it should be fixed, and not subject to the whims and fancies of the policy maker). Assume everything else remains as stated in the beginning of the question. Could the policy maker achieve his objective? Why or why not?

Ans:

With a fixed exchange rate, the policy maker cannot do independent monetary policy. At once, the objective of reducing the trade deficit while keeping output unaffected, is no longer attainable.