Lecture 14 - Recommended Problems Solutions

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Intermediate Macroeconomics, Econ 102

☆☆☆ Chapter 18, Problem 7

Multipliers, openness, and fiscal policy. Consider an open economy characterized by the following equations:

$$\begin{aligned} C &= c_0 + c_1 (Y - T) \\ I &= d_0 + d_1 Y \\ IM &= m_1 Y \\ X &= x_1 Y^* \end{aligned}$$

The parameters m_1 and x_1 are the propensities to import and export. Assume that the real exchange rate is fixed at a value of 1 and treat foreign income, Y^*, as fixed. Also assume that taxes are fixed and that government purchases are exogenous (i.e., decided by the government). We explore the effectiveness of changes in G under alternative assumptions about the propensity to import.

a. **Write the equilibrium condition in the market for domestic goods and solve for Y**

The equilibrium condition in the market for domestic goods writes, since $\epsilon = 1$:

$$\begin{aligned} Y = Z &= C + I + G + X - IM \\ &= c_0 + c_1(Y - T) + d_0 + d_1 Y + G + x_1 Y^* - m_1 Y. \end{aligned}$$

Solving for Y gives the same expression as in the class, with $d_1 = b_1$, $d_0 = b_0$, and $\epsilon = 1$:

$$Y = \frac{1}{1 - (c_1 + d_1 - m_1)}(c_0 - c_1 T + d_0 + G + x_1 Y^*).$$

b. **Suppose government purchases increase by one unit. What is the effect on output? (Assume $0 < m_1 < c_1 + d_1 < 1$. Explain why.)**

One unit increase in G leads to a $\frac{1}{1-(c_1+d_1-m_1)}$ increase in output. The condition $0 < m_1 < c_1 + d_1 < 1$ ensures that the multiplier is not infinite. As compared to

the original multiplier, $\frac{1}{1-c_1}$, there are two additional parameters: d_1, which captures the effect of an additional unit of income on investment, and m_1, which captures the effect of an additional unit of income on imports. The investment effect tends to increase the multiplier; the import effect tends to reduce the multiplier.

c. **How do net exports change when government purchases increase by one unit?**

$$NX = X - IM = x_1 Y^* - m_1 Y.$$

One unit increase in G leads to $\frac{1}{1-(c_1+d_1-m_1)}$ dollars of increase in output Y, which in turn leads to $\frac{m_1}{1-(c_1+d_1-m_1)}$ dollars of decline in net exports.

Now consider two economies, one with $m_1 = 0.5$ and the other with $m_1 = 0.1$. Each economy is characterized by $(c_1 + d_1) = 0.6$.

d. **Suppose one of the economies is much larger than the other. Which economy do you expect to have larger value of m_1? Explain.**

The smaller economy should have the highest ratio of openness, and therefore for this smaller economy $m_1 = 0.5$. $m_1 = 0.5$ means half of the income are spent on imported goods from a foreign country, which is more plausible in a small economy. Larger economies produce a larger variety of goods and as a result spend more income on domestic goods.

e. **Calculate your answers to part (b) and (c) for each economy by substituting the appropriate parameter values.**

When $m_1 = 0.5$, one unit increase in G leads to a $\frac{1}{1-(c_1+d_1-m_1)} = 1.11$ units increase in output, and $\frac{m_1}{1-(c_1+d_1-m_1)} = 0.56$ unit decline in net export. Keynesian effects are more muted in open economies because there is more demand leakages in open economies.

When $m_1 = 0.1$, one unit increase in G leads to a $\frac{1}{1-(c_1+d_1-m_1)} = 2$ units increase in output, and $\frac{m_1}{1-(c_1+d_1-m_1)} = 0.2$ unit decline in net exports. For this reason, the Keynesian multiplier is larger in the United States, say, than in a small open economy like the Netherlands.

f. **In which economy will fiscal policy have a larger effect on output? In which economy will fiscal policy have a larger effect on net exports?**

In the economy where $m_1 = 0.1$ (the large economy), fiscal policy has a larger effect on output. Fiscal Policy has a larger effect on net exports in the relatively small economy. Comment. A similar effect occurs across different states in the US. US States have a larger openness ratio than the US as a whole (because of specialization: for example, Hollywood exports movies to the of the US), and therefore fiscal policy has a smaller effect if implemented solely in California than in the US as a whole: exports of movies will rise only if the whole US has higher aggregate demand.

☆☆☆ Chapter 18, Problem 8

Policy coordination and the world economy. Consider an open economy in which the real exchange rate is fixed an equal to one. Consumption, investment, government spending and taxes are given by:

$$\begin{aligned} C &= 10 + 0.8(Y - T) \\ I &= 10 \\ G &= 10 \\ T &= 10 \end{aligned}$$

Imports and exports are given by:

$$\begin{aligned} IM &= 0.3Y \\ X &= 0.3Y^* \end{aligned}$$

where Y^* denotes foreign output.

a. **Solve for equilibrium output in the domestic economy, given Y^*. What is the multiplier in this economy? If we were to close the economy - so exports and imports were identical equal to zero - what would be the multiplier be? Why would the multiplier be different in a closed economy?**

Because the real exchange rate is fixed and equal to 1, $\epsilon = 1$:

$$\begin{aligned} Y = Z &= C + I + G + X - IM \\ &= 10 + 0.8(Y - 10) + 10 + G + 0.3Y^* - 0.3Y, \end{aligned}$$

this gives:

$$Y = \frac{1}{1 - (0.8 - 0.3)}(12 + G + 0.3Y^*).$$

The multiplier in this economy is $\frac{1}{1-(0.8-0.3)} = 2$.

If instead we were to close the economy, the multiplier would then be $\frac{1}{1-0.8} = 5$, a larger number. In an open economy, part of the increase in income will be spent on imports, so this makes the multiplier smaller. There is some leakage of aggregate demand.

b. **Assume that the foreign economy is characterized by the same equations as the domestic economy (with asterisks reversed). Use the two sets of equations to solve for the equilibrium output of each country. [Hint: Use the equations for the foreign economy to solve for Y^* as a function of Y and substitute this solution for Y^* in part (a).] What is the multiplier in each country now? Why is it different from the open economy multiplier in part (a)?**

Following part (a), output in the two economies is characterized by the following two equations:

$$Y = 2 \times (12 + G + 0.3Y^*), \tag{1}$$

$$Y^* = 2 \times (12 + G^* + 0.3Y) \tag{2}$$

Plugging equation (2) into equation (1) gives:

$$Y = 2 \times (12 + G + 0.3 * 2 * (12 + G^* + 0.3Y)).$$

Solving for Y,

$$Y = 60 + 3.125G + 1.875G^*. \tag{3}$$

Symmetrically, we have:

$$Y^* = 60 + 3.125G^* + 1.875G. \tag{4}$$

Note that the same expression could be obtained starting from the expression for the home economy's demand:

$$\begin{aligned} Y &= 10 + 0.8(Y - 10) + 10 + G + 0.3Y^* - 0.3Y \\ Y &= 12 + G + 0.5Y + 0.3Y^* \end{aligned}$$

The foreign economy's demand is similarly given by:

$$Y^* = 12 + G^* + 0.5Y^* + 0.3Y$$

Therefore, we now have a system of two equations and two unknowns to determine Y and Y^* as a function of the amounts of home government spending G and of foreign government spending G^*. This system leads to the same equations (3) and (4) as above.

Finally, $G = G^* = 10$, $Y = 110$. When $G = G^* = 10$, $Y^* = 110$. We also see from (3) that one unit of increase in G leads to 3.125 units of increase in total output Y. **The multiplier is 3.125.**

c. **Assume that the domestic government, G, has a target level of output of of 125. Assuming that the foreign government does not change G^*. what is the increase in G necessary to achieve the target output in domestic economy? Solve for net exports and the budget deficit in each country.**

To achieve $125 - 110 = 15$ units of increase in output, if foreign government does not change G^*, given a multiplier of 3.125, G will need to be increased by $\frac{15}{3.125} = 4.8$ units to $G = 14.8$.

Notice the increase in G also improves the output in foreign country. Using equation (4), $Y^* = 119$.

In the domestic economy, net exports are given by $NX = 0.3Y^* - 0.3Y = -1.8$, and there is a budget deficit given by $T - G = -4.8$.

In the foreign economy, net exports are given by $NX^* = 0.3Y - 0.3Y^* = 1.8$ (this is logically the opposite), while the budget deficit $T^* - G^* = 0$.

We see that given the increase of domestic government spending, the foreign economy now has a trade surplus, an increase in output, and a balanced budget.

Comment. There are large gains in freeriding on other countries' efforts at boosting their aggregate demand ! You get a trade surplus a boost in output, and it costs nothing!

d. **Suppose that each government has a target level of output of 125 and that each government increases government spending by the same amount. What is the common increase in G and G^* necessary to achieve the target output in both countries? Solve for net exports and the budget deficit in each country.**

We solve for the level of government spending $G = G^* = \bar{G}$ such that output is $Y = 125$. Using equation (3), we get:

$$\begin{aligned} 125 &= 60 + 5\bar{G} \\ \Rightarrow \quad \bar{G} &= 13. \end{aligned}$$

Government spending in both countries will need to increase by 3 units to $G = G^* = 13$. Net exports in both countries are zero, and budget deficits in both countries are $T - G = T - G^* = -3$.

Comment. This time, there is no free-riding: both countries make an effort at boosting aggregate demand.

e. **Why is fiscal coordination, such as the common increase in G and G^* in part (d), difficult to achieve in practice?**

Fiscal coordination is difficult to achieve in practice because there are big incentives to free ride on each others' efforts at boosting aggregate demand. In particular, the economy that is more in need of aggregate demand growth has more incentives to go fiscal expansion, and so the other economy might just be waiting for that to happen. The big advantage is that the country which free-rides at the expense of other countries does not incur any additional public debt.

☆☆ Chapter 18, Problem 3

A European recession and the U.S. economy.

a. **In 2014, European Union spending on U.S. goods accounted for 18% of U.S. exports, and U.S. exports amounted to 15% of U.S. GDP. What is the share of European Union spending on U.S. goods relative to U.S. GDP?**

The share of European spending on U.S. goods is $15\% \times 18\% =$ **2.7% of US GDP**.

b. **Assume that the multiplier in the United States is 2 and that a major slump in Europe would reduce output and imports from the U.S. by 5% (relative to its normal level). Given your answer to part (a), what is the impact on U.S. GDP of the European slump?**

A 5% decline of European imports to U.S. leads to a $5\% \times 2.7\%$ decline in demand for U.S. exports. Given a multiplier of 2, US GDP will drop by $2 \times 5\% \times 2.7\% = 0.27\%$.

c. **If the European slump also leads to a slowdown of the other economies that import goods from the United States, the effect could be larger. To put a bound to the size of the effect, assume that U.S. exports decrease by 5% (as a result of changes in foreign output) in one year. What is the effect of a 5% drop in exports on U.S. GDP?**

A 5% decline drop in demand for U.S. exports will lead to a $5\% \times 15\%$ decline in demand for U.S. exports. Given a multiplier of 2, U.S. GDP will drop by $2 \times 5\% \times 15\% =$ **1.5% of GDP**.
Comment. The implicit assumption here is that all economies, not just Europe, will import 5% less from the US. This is likely to be an upper bound, as second round effects are typically smaller than first round effects.

☆☆ Chapter 18, Problem 6

Eliminating a trade deficit.

a. **Consider an economy with a trade deficit ($NX < 0$) and with output equal to its natural level. Suppose that, even though output may deviate from its natural level in the short run, it returns to its natural level in the medium run. Assume that the natural level is unaffected by the real exchange rate. What must happen to the real exchange rate over the medium run to eliminate the trade deficit (i.e., to increase NX to 0)?**

I, the medium run, output will return to its natural level anyway. Therefore, the increase in NX will not overheat the economy. In order for the trade deficit to increase to 0, there must therefore be a depreciation of the real exchange rate, provided of course that the Marshall-Lerner condition is satisfied:

$$d\epsilon < 0 \quad \Rightarrow \quad \frac{dNX}{X} = \frac{dX}{X} - \frac{dIM}{IM} + \frac{d\epsilon}{\epsilon} > 0.$$

b. **Now write down the national income identity. Assume again that output returns to its natural level in the medium run. If NX increases to 0, what must happen to domestic demand $(C + I + G)$ in the medium run? What government policies are available to reduce domestic demand in the medium run? Identify which components of domestic demand each of these policies affect.**

The national income identity writes as follows:

$$Y = Z = C + I + G + X - \frac{IM}{\epsilon}$$

IfNX increases to 0, and output overall returns to its natural level, then it must be that domestic demand $(C + I + G)$ falls. There are several ways that the government can use in order to reduce domestic demand. It may increase government spending G, or increase taxes T, which both however would also have effects on imports directly, and thus have an impact on the trade deficit directly.

☆ Chapter 19, Problem 9

The U.S. trade deficit, current account deficit, and investment.

Table 1: Average of $\frac{NX}{GDP}$ and $\frac{GDPIA}{GDP}$ at Different Periods

Period	1980 - 1989	1990 - 1999	2000 - 2017
Average of $\frac{NX}{GDP}$	-1.75%	-1.25%	-3.85%
Average of $\frac{GDPIA}{GDP}$	18.48%	17.27%	16.95%

a. **Define national saving as private saving plus the government surplus – that is, as $S+T-G$. Now, using equation (18.5), describe the relation among the current account deficit, net investment income, and the difference between national saving and domestic investment.**

Equation (18.5) is

$$CA = S^{private} + (T - G) - I.$$

Since $S^{national} = S^{private} + (T - G)$, we have:

$$CA = S^{national} - I.$$

Therefore:

$$CA = NX + NI + NT = S^{national} - I. \tag{5}$$

The current account is equal to net exports plus net income and net transfers from abroad, which in turn is equal to the difference between national saving and investment.

b. **Using the FRED economic database retrieve annual data for nominal GDP (series GDP). gross domestic investment (series GDPIA), and net exports (series A019RC1A027NBEA) from 1980 to the most recent year available. Divide gross domestic investment and net exports by GDP in each year to express their values as a percentage of GDP. What year has the largest trade deficit as a percentage of GDP?**

The data can be found in the spreadsheet online by clicking here. The year 2006 has the largest trade deficit as a percentage of GDP.

c. **The trade surplus in 1980 was roughly zero. Compute the average percentage of GDP invested and the average value of the trade balance as a percent of GDP in three periods: 1980-1989, 1990-1999, 2000 to the latest point. Would it appear that trade deficits have been used to finance investment?**

The data can be found in the spreadsheet online by clicking here. As summarized in Table 1, the average of net export as a percentage of GDP increases from -1.75% in the period of 1980-1989 to -3.85% in the period of 2000-2017. However, the average gross domestic investment as a percentage of GDP decreases from 18.48% in the period of 1980-1989 to 16.95% in the period of 2000-2017. Therefore, it does not appear that trade deficits have been used to finance investment.

d. **Is a trade deficit more worrisome when not accompanied by a corresponding increase in investment? Explain your answer.**

Yes. an increase in investment leads to more capital accumulation and more output in the future, and therefore to a greater ability to repay foreign debt.

e. **The previous question focuses on the trade deficit rather than the current account deficit. How does net investment income (NI) relate to the difference between the trade deficit and the current account deficit in the United States? You can download GDP (series GDP) and GNP (series GNP) from the FRED database at the Federal reserve Bank of St. Louis. This difference is a measure of NI. Is this value rising or falling over time? What is the implication of such changes?**

Investment income (NI) relates to the difference between the trade deficit and the current accout deficit in the United States through the following identity:

$$CA = NX + NT + NI$$

Since NT are relatively small and do not change much, net income accounts for most of the discrepancy between the current account and net exports. The data can be found in the spreadsheet online by clicking here. We see that NI, the difference between GNP and GDP, is rising over time. This means Americans are earning a larger proportion of their income on foreign investments. The implication is that net income somewhat offsets the negative balance of trade the US is running vis-à-vis the rest of the world. The current account deficit is less negative than is the trade balance, and increasingly so.