Lecture 11 - The Open Economy and the Multiplier

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Contents

11 The Open Economy and the Multiplier

In lectures **??**, **??**, **??** and **??**, we have maintained that the economy was closed, a strong and unrealistic assumption. This assumption can only be justified when thinking about the world as a whole. However, the relevance of the theory is then considerably diminished, because fiscal policy such as government spending or the tax and transfer system, are largely decided at the national level.

One key idea of today's lecture is that in an open economy, Keynesian stimulus is less efficient, which is all the more true when the economy is more open. This result is intuitive: in an open economy, some of the increased aggregate demand by consumers is addressed to foreign products. J.M. Keynes describes this phenomenon in *The General Theory of Employment, Interest and Money* as follows:

> In an open system with foreign-trade relations, some part of the multiplier of the increased investment will accrue to the benefit of employment in foreign countries, since a proportion of the increased consumption will diminish our own country's favourable foreign balance; so that, if we consider only the effect on domestic employment as distinct from world employment, we must diminish the full figure of the multiplier. On the other hand our own country may recover a portion of this leakage through favourable repercussions due to the action of the multiplier in the foreign country in increasing its economic activity.

During this lecture, we will extend the extended goods market model of lecture **??** to allow for the importing and exporting of goods, as well as the potential for a deficit or a surplus in the trade balance NX. We will show that the value for the Keynesian multiplier is then reduced, all the more so that the economy is open.

Very importantly, you should not necessarily think of the economies we consider here as countries. States, counties, or even zipcodes, also are open economies (which share a fixed exchange rate with respect to other states, counties, or zipcodes). Thus, the model is applicable if, for example, California decides to engage in fiscal stimulus (by lowering state taxes, for instance). Of course, California is much more open than the U.S. as a whole, as California imports many products from other states (a quarter of its electricity, for example), and exports many products to other states (such as Google, Apple, or Facebook). Therefore, we shall see that California has much less power than the U.S. as a whole to stimulate aggregate demand.

11.1 Aggregate Demand in the Open Economy

11.1.1 Assumption: No Exchange Rates

In this lecture, we shall abstract from exchange rate considerations altogether (in terms of the notations which we shall introduce later, $\epsilon = 1$):

1. A literal way to interpret this assumption is to assume that **exchange rates are fixed**. This would be the case if a country has a fixed exchange rate regime vis-a-vis the rest of the world. This situation describes well Euro-area countries which share a common currency, or countries which peg their currencies to the dollar. This situation also describes the Gold Standard regime, or the "gold-exchange standard" Bretton Woods system before the Nixon Shock, when direct convertibility of the U.S. dollar to Gold was suspended.
2. Even if exchange rates are not fixed, we can already learn a lot by **focusing on quantities** (export and import volumes), and abstracting from exchange rates for now. We shall discuss exchange rate policy during some of the next lectures. In particular, even though exports and imports are clearly endogenous to exchange rates, it is useful to first ask what would happen if exchange rates could not move.

11.1.2 National Accounting

In the open economy, aggregate demand for U.S. goods has two additional components:

- exports X, which add to demand for U.S. goods. This additional demand originates from the spending of foreign countries.
- imports M, which substract from demand for U.S. goods. (this additional demand is met by countries from which the U.S. imports)

Therefore, in the open economy, aggregate demand Z is given by:

$$Z = C + I + G + (X - M).$$

Net exports NX are defined as exports minus imports:

$$NX \equiv X - M.$$

Aggregate demand for U.S. goods is thus:

$$\boxed{Z = C + I + G + NX}.$$

11.2 Multiplier in the Open Economy

In this section, we will illustrate the aggregate demand leakage effect, using the simplest possible model. A natural assumption is that imports are a constant fraction of aggregate demand, so that:

$$M = m_1 Y.$$

For example, if the import penetration ratio is 15%, then $m_1 = 0.15$. This means that out of \$1 in additional demand, 15 cents is addressed to foreign products. A symmetric assumption is that exports are a constant fraction of foreign demand, denoted by Y^*. We denote the constant of proportionality by x_1, for symmetry, so that:

$$X = x_1 Y^*.$$

We can already see that if aggregate demand abroad increases, then the home country has an aggregate demand boost, because it is able to sell more abroad.

11.2.1 Output in the Open Economy

We shall now use the most sophisticated model of the goods market, that seen in lecture **??**.[1] Therefore, we shall assume a population of size N with two types of consumers, a fraction λ who earn a low income $\underline{y}$ and a

[1] Starting from the most general model allows to then look at particular cases if it need be, while the reverse is obviously not true.

fraction $1-\lambda$ with a high income $\bar{y} = \gamma \underline{y}$. They respectively consume $\underline{c} = \underline{c}_0 + \underline{c}_1(\underline{y} - \underline{t})$ with $\underline{t} = \underline{t}_0 + t_1 \underline{y}$, and $\bar{c} = \bar{c}_0 + \bar{c}_1(\bar{y} - \bar{t})$ with $\bar{t} = \bar{t}_0 + t_1 \bar{y}$. Moreover, we assume that investment depends on output through $I = b_0 + b_1 Y$.

In lecture **??**, we have shown that defining aggregate baseline taxes for the two groups as:

$$\underline{T}_0 \equiv \lambda N \underline{t}_0, \qquad \bar{T}_0 \equiv (1-\lambda) N \bar{t}_0,$$

aggregate taxes T satisfy:

$$\boxed{T = \left(\underline{T}_0 + \bar{T}_0\right) + t_1 Y}.$$

Moreover, defining the average MPC c_1 by:

$$c_1 \equiv \frac{\lambda \underline{c}_1 + (1-\lambda)\gamma \bar{c}_1}{\lambda + (1-\lambda)\gamma},$$

the aggregate baseline level of consumption C_0 as:

$$C_0 \equiv \underline{C}_0 + \bar{C}_0 = \lambda N \underline{c}_0 + (1-\lambda) N \bar{c}_0,$$

where the baseline level of consumption for low and high income earners is given by:

$$\underline{C}_0 \equiv \lambda N \underline{c}_0, \qquad \bar{C}_0 \equiv (1-\lambda) N \bar{c}_0.$$

Aggregate consumption is:

$$\boxed{C = C_0 - \left(\underline{c}_1 \underline{T}_0 + \bar{c}_1 \bar{T}_0\right) + c_1(1-t_1)Y}.$$

We may now express total aggregate demand in the open economy as:

$$\begin{aligned} Z &= C + I + G + X - M \\ &= C_0 - \left(\underline{c}_1 \underline{T}_0 + \bar{c}_1 \bar{T}_0\right) + c_1(1-t_1)Y + b_0 + b_1 Y + G + x_1 Y^* - m_1 Y \\ Z &= \left[C_0 - \left(\underline{c}_1 \underline{T}_0 + \bar{c}_1 \bar{T}_0\right) + b_0 + G + x_1 Y^*\right] + \left[c_1(1-t_1) + b_1 - m_1\right] Y \end{aligned}$$

We can now write that aggregate demand equals income, or $Z = Y$, which leads to:

$$\begin{aligned} & Y = \left[C_0 - \left(\underline{c}_1 \underline{T}_0 + \bar{c}_1 \bar{T}_0\right) + b_0 + G + x_1 Y^*\right] + \left[c_1(1-t_1) + b_1 - m_1\right] Y \\ & \quad \Rightarrow \quad (1 - c_1(1-t_1) - b_1 + m_1) Y = C_0 - \left(\underline{c}_1 \underline{T}_0 + \bar{c}_1 \bar{T}_0\right) + b_0 + G + x_1 Y^* \end{aligned}$$

To conclude:

$$\boxed{Y = \frac{1}{1 - c_1(1-t_1) - b_1 + m_1}\left[C_0 - \left(\underline{c}_1 \underline{T}_0 + \bar{c}_1 \bar{T}_0\right) + b_0 + G + x_1 Y^*\right]}$$

11.2.2 Open Economy Multiplier

Denoting autonomous spending by z_0 as in lecture **??**:

$$z_0 \equiv C_0 - \left(\underline{c}_1 \underline{T}_0 + \bar{c}_1 \bar{T}_0\right) + b_0 + G + x_1 Y^*,$$

we note that a given change in autonomous spending Δz_0, which may arise for example from a change in government spending $\Delta z_0 = \Delta G$ leads to a change in output given by:

$$\Delta Y = \frac{\Delta z_0}{1 - c_1(1-t_1) - b_1 + m_1}.$$

This implies the following value for the **open economy multiplier**:

$$\boxed{\text{Multiplier} = \frac{1}{1 - c_1(1-t_1) - b_1 + m_1}}.$$

We can see that that the open economy multiplier is lower than the closed economy multiplier (which we get back here assuming that $m_1 = 0$):

$$\frac{1}{1 - c_1(1 - t_1) - b_1 + m_1} < \frac{1}{1 - c_1(1 - t_1) - b_1}.$$

Or:

$$\boxed{\text{Open Economy Multiplier} < \text{Closed Economy Multiplier}}$$

The economics of this result are very clear: in an open economy, some of the stimulus goes to increase imports, which does not stimulate production at home. This explains J.M. Keynes' observation we started out with:

> In an open system with foreign-trade relations, some part of the multiplier of the increased investment will accrue to the benefit of employment in foreign countries, since a proportion of the increased consumption will diminish our own country's favourable foreign balance; so that, if we consider only the effect on domestic employment as distinct from world employment, we must diminish the full figure of the multiplier.

Numerical Application: If we assume that $m_1 = 1/6$, adding the numerical values used in lecture **??** for c_1, b_1 and t_1:

$$c_1 = \frac{2}{3}, \quad b_1 = \frac{1}{6}, \quad t_1 = \frac{1}{4}, \quad m_1 = \frac{1}{6}.$$

(note that the marginal propensity to consume is again here an average across the two groups, which could come from $\underline{c}_1 = 1, \bar{c}_1 = 1/3, \gamma = 9, \lambda = 0.9$ implying that $c_1 = 2/3$ as in lecture **??**), then we may calculate the government spending multiplier:

$$\begin{aligned}
\frac{1}{1 - c_1(1 - t_1) - b_1 + m_1} &= \frac{1}{1 - (1 - 1/4) \cdot 2/3 - 1/6 + 1/6} \\
&= \frac{1}{1 - 1/2} \\
\frac{1}{1 - c_1(1 - t_1) - b_1 + m_1} &= 2
\end{aligned}$$

This can be compared to the closed economy multiplier wih $m_1 = 0$:

$$\begin{aligned}
\frac{1}{1 - c_1(1 - t_1) - b_1} &= \frac{1}{1 - (1 - 1/4) \cdot 2/3 - 1/6} \\
&= \frac{1}{1 - 1/2 - 1/6} \\
\frac{1}{1 - c_1(1 - t_1) - b_1} &= 3
\end{aligned}$$

11.3 Twin Deficits?

Martin Feldstein, an economist who was serving as chairman of the Council of Economic Advisors and as chief economic advisor to Ronald Reagan from 1982 to 1984, coined the term "twin deficits" to describe the Reagan policies of large government deficits, caused by tax cuts and large military expenditures (he was actually very critical of these policies, as he was and still is a "deficit hawk". At the time, the U.S. was experiencing a deficit in both the trade balance as well as in the government's finances. How can we make sense of this twin deficit idea, using the very simple goods market model of the previous section? Do trade deficits always come in times of budget deficits?

11.3.1 "Saving Equals Investment" in the open economy

In the closed economy, total saving (private plus government) must equal investment:

$$S + (T - G) = I.$$

The logic is rather straightforward: when the economy is closed, increased capital accumulation can only come out of resources which have not been consumed. In the open-economy, the trade balance equals exactly the difference between total saving and total investment:

$$\boxed{NX = S + (T - G) - I}.$$

Just as the Saving Equals Investment Identity obtains using the national account identity in a closed economy, so does this previous relationship. We start from:

$$Y = C + I + G + NX$$

This leads to:

$$\begin{aligned} NX &= Y - C - G - I \\ &= (Y - C - T) + (T - G) - I \\ NX &= S + (T - G) - I. \end{aligned}$$

Logic of twin deficits. The logic of twin deficits is quite straightforward. Assuming **everything else equal**, a fall in the government surplus $(T - G)$, or equivalently a rise in the government deficit, leads to a deterioration in ths trade balance:

$$\boxed{\Delta(T - G) < 0 \quad \Rightarrow \quad NX < 0}.$$

However, things are never quite so simple in macroeconomics, as **everything tends to depend on everything else** ; this is actually one reason why we write models with exogenous and endogenous variables. "Changing the budget deficit everything else equal" is not a concrete experiment, because whatever changes the budget deficit also typically affects private saving, and potentially investment. So let's look more precisely at what may or may not lead to a twin deficit.

11.3.2 A Budget Deficit and a Trade Deficit

The question that always needs to be asked in macroeconomics is: what is exogenous, and what is endogenous? The government typically cannot legislate on the budget deficit directly: for example, the budget deficit depends on GDP through automatic stabilizers (which affect the amount of taxes that are levied); and many determinants of GDP are not directly under the government's control.

However, the government does decide on government spending. Let us therefore look at what happens when the U.S. engage in military expenditures $\Delta G > 0$, as Reagan did at the beginning of the 1980s. We will see that under "reasonable" assumptions on parameters, government expenditures lead to a twin deficit in the budget and in trade.

Let us look at GDP first. From section 11.2.1, we know that:

$$\Delta Y = \frac{\Delta G}{1 - c_1(1 - t_1) - b_1 + m_1}.$$

Because $T = \left(\underline{T}_0 + \bar{T}_0\right) + t_1 Y$, we have that:

$$\begin{aligned} \Delta T &= t_1 \Delta Y \\ \Delta T &= \frac{t_1 \Delta G}{1 - c_1(1 - t_1) - b_1 + m_1} \end{aligned}$$

This implies that the public deficit is:

$$\begin{aligned} \Delta(T - G) &= \Delta T \\ &= \Delta T - \Delta G \\ &= \frac{t_1 \Delta G}{1 - c_1(1 - t_1) - b_1 + m_1} - \Delta G \\ \Delta(T - G) &= \left(\frac{t_1}{1 - c_1(1 - t_1) - b_1 + m_1} - 1\right) \Delta G. \end{aligned}$$

In all generality, the sign for this is ambiguous. However, with "reasonable values" such as $c_1 = 2/3$, $t_1 = 1/4$, $b_1 = 1/6$ and $m_1 = 1/6$, the government multiplier is 2, so that with $t_1 = 1/4$, increases in government expenditures are not self-financing:

$$\frac{t_1}{1 - c_1(1-t_1) - b_1 + m_1} - 1 = \frac{2}{4} - 1 = -\frac{1}{2}.$$

Therefore, the increase in taxes brought about by the Keynesian stimulus are not enough to offset the negative impact of governent spending on the budget, so that overall:

$$\boxed{\Delta(T-G) < 0}.$$

The impact on the trade deficit can be computed directly using that net exports are $NX = x_1 Y^* - m_1 Y$, so that:

$$\Delta NX = -m_1 \Delta Y$$
$$\Delta NX = -m_1 \frac{\Delta G}{1 - c_1(1-t_1) - b_1 + m_1}$$

This implies therefore that we also have a trade deficit:

$$\boxed{\Delta NX < 0}.$$

Intuition. However, what is somewhat frustrating with this way of computing the trade deficit, is that we don't see the intuition that we started with: net exports are saving minus investment, so if government saving goes down, then necessarily net exports must go down. What is going on? We now write this equation in changes to try to get at this result:

$$\Delta NX = \Delta S + \Delta(T - G) - \Delta I.$$

What this equation shows is that there are two potential "moving parts" that the previous simplistic reasoning was not taking into account: one, saving might go up if output goes up, which helps create a trade surplus; two, investment might go up as well if output goes up, which might further aggravate the deficit. In order to tell which of these forces dominate, we need to do some algebra. First, private saving is still given by disposable income minus consumption:

$$\begin{aligned}
S &= Y - T - C \\
&= Y - \left(\left(\underline{T}_0 + \bar{T}_0\right) + t_1 Y\right) - \left(C_0 - \left(\underline{c}_1 \underline{T}_0 + \bar{c}_1 \bar{T}_0\right) + c_1(1-t_1)Y\right) \\
&= Y - t_1 Y - c_1(1-t_1)Y - C_0 - \left(\underline{T}_0 + \bar{T}_0\right) + \left(\underline{c}_1 \underline{T}_0 + \bar{c}_1 \bar{T}_0\right) \\
S &= (1-t_1)(1-c_1)Y - C_0 - \left(\underline{T}_0 + \bar{T}_0\right) + \left(\underline{c}_1 \underline{T}_0 + \bar{c}_1 \bar{T}_0\right)
\end{aligned}$$

Therefore:

$$\Delta S = (1-t_1)(1-c_1)\Delta Y$$
$$\Delta S = \frac{(1-t_1)(1-c_1)}{1 - c_1(1-t_1) - b_1 + m_1} \Delta G$$

Again, as above, taxes also increase through automatic stabilizers. Because $T = \left(\underline{T}_0 + \bar{T}_0\right) + t_1 Y$, we have that:

$$\Delta T = t_1 \Delta Y$$
$$\Delta T = \frac{t_1}{1 - c_1(1-t_1) - b_1 + m_1} \Delta G$$

Finally, investment increases by the following amount:

$$\Delta I = b_1 \Delta Y$$
$$\Delta I = \frac{b_1}{1 - c_1(1-t_1) - b_1 + m_1} \Delta G$$

So finally, net exports minus investment is the sum of all these contributions:

$$\begin{aligned}\Delta NX &= \Delta S + \Delta T - \Delta G - \Delta I\\ &= \frac{(1-t_1)(1-c_1)+t_1-(1-c_1(1-t_1)-b_1+m_1)-b_1}{1-c_1(1-t_1)-b_1+m_1}\Delta G\\ &= \frac{1-t_1-c_1+c_1t_1+t_1-1+c_1-c_1t_1+b_1-m_1-b_1}{1-c_1(1-t_1)-b_1+m_1}\Delta G\\ \Delta NX &= -\frac{m_1}{1-c_1(1-t_1)-b_1+m_1}\Delta G\end{aligned}$$

Naturally (but it's always nice to check !), we arrive at the same result in the end.

Numerical Application: If we assume again $m_1 = 1/6$, $c_1 = 2/3$, $b_1 = 1/6$, $t_1 = 1/4$, then again the multiplier $\Delta Y/\Delta G$ is (see above):

$$\begin{aligned}\frac{\Delta Y}{\Delta G} &= \frac{1}{1-c_1(1-t_1)-b_1+m_1}\\ &= \frac{1}{1-(2/3)\cdot(1-1/4)-1/6+1/6}\\ \frac{\Delta Y}{\Delta G} &= 2\end{aligned}$$

Thus, if government spending increases by 1 so $\Delta G = 1$, we get $\Delta Y = 2$ for the increase in output. For the budget deficit, we get only $\Delta(T-G) = -1/2$:

- A direct effect $\Delta G = 1$.
- An indirect effect coming from automatic stabilizers, improving the budget situation $\Delta T = t_1 \Delta Y = 1/4 \cdot 2 = 1/2$.

For the trade deficit, we get $\Delta NX = -1/3$:

- A direct effect $\Delta G = 1$.
- An indirect effect coming from automatic stabilizers, improving the budget situation $\Delta T = t_1 \Delta Y = 1/4 \cdot 2 = 1/2$.
- An indirect effect increasing private saving, working to improve the trade balance $\Delta S = (1-t_1)\cdot(1-c_1)\cdot\Delta Y = (3/4)\cdot(1/3)\cdot 2 = 1/2$.
- An indirect effect increasing investment, working to worsen the trade balance $\Delta I = b_1 \Delta Y = 1/6 \cdot 2 = 1/3$.

The sum of all these contributions is:

$$\begin{aligned}\Delta NX &= \Delta S + \Delta T - \Delta G - \Delta I\\ &= \frac{1}{2}+\frac{1}{2}-1-\frac{1}{3}\\ \Delta NX &= -\frac{1}{3}.\end{aligned}$$

11.3.3 A Budget Surplus and a Trade Deficit

Another way to illustrate that "everything depends on everything" in macroeconomics is to show that trade deficits may actually very well come together with government surpluses. One such example is that of redistributive policies from the rich to the poor, which we studied in section **??**. In one exercise, we imagined a reduction in taxes on the poor $\Delta \underline{T}_0 < 0$, with an offsetting increase in taxes on high income earners such that $\Delta T_0 = \Delta \underline{T}_0 + \Delta \bar{T}_0 = 0$. We then have that $\Delta \bar{T}_0 = -\Delta \underline{T}_0 > 0$. We showed that this impulse leads to an increase in output given by:

$$\Delta Y = \frac{\underline{c}_1 - \bar{c}_1}{1-(1-t_1)\,c_1 - b_1}\Delta \bar{T}_0 > 0.$$

In the case of the open economy, we get a very similar formula. Indeed, aggregate consumption is given as shown in lecture **??** by:

$$C = C_0 - \left(\underline{c}_1 \underline{T}_0 + \bar{c}_1 \bar{T}_0\right) + c_1(1-t_1)Y,$$

where we have defined the average MPC c_1 as a function of $\underline{c}_1$ and $\bar{c}_1$ by:

$$c_1 \equiv \frac{\lambda \underline{c}_1 + (1-\lambda)\gamma \bar{c}_1}{\lambda + (1-\lambda)\gamma}.$$

Using that Z is $C+I+G+X-M$, we get:

$$\begin{aligned}
Z &= C + I + G + X - M \\
&= C_0 - \left(\underline{c}_1 \underline{T}_0 + \bar{c}_1 \bar{T}_0\right) + c_1(1-t_1)Y + b_0 + b_1 Y + G + x_1 Y^* - m_1 Y \\
Z &= \left[C_0 - \left(\underline{c}_1 \underline{T}_0 + \bar{c}_1 \bar{T}_0\right) + b_0 + G + x_1 Y^*\right] + \left(c_1(1-t_1) + b_1 - m_1\right) Y
\end{aligned}$$

Equating output to demand $Z = Y$ gives the value for output:

$$Y = \frac{1}{1-(1-t_1)\,c_1 - b_1 + m_1}\left[C_0 - \underline{c}_1 \underline{T}_0 - \bar{c}_1 \bar{T}_0 + b_0 + G + x_1 Y^*\right]$$

A reduction in taxes on the poor $\Delta \underline{T}_0 < 0$, with an offsetting increase in taxes on high income earners such that $\Delta T_0 = \Delta \underline{T}_0 + \Delta \bar{T}_0 = 0$ therefore leads to a change in output given by:

$$\Delta Y = \frac{\underline{c}_1 - \bar{c}_1}{1-(1-t_1)\,c_1 - b_1 + m_1}\Delta \bar{T}_0 > 0.$$

Using the value for aggregate taxes $\Delta \underline{T}_0 + \Delta \bar{T}_0 = 0$, we now get that aggregate taxes are higher because of automatic stabilizers, just as in lecture **??**:

$$\begin{aligned}
\Delta T &= \Delta \underline{T}_0 + \Delta \bar{T}_0 + t_1 \Delta Y \\
&= t_1 \Delta Y \\
\Delta T &= \frac{t_1\left(\underline{c}_1 - \bar{c}_1\right)}{1-(1-t_1)\,c_1 - b_1 + m_1}\Delta \bar{T}_0 > 0.
\end{aligned}$$

This unambiguously leads to a reduction in the public deficit, or an increase in public saving, as in lecture **??**, because of automatic stabilizers:

$$\begin{aligned}
\Delta\left(T-G\right) &= \Delta T \\
\Delta\left(T-G\right) &= \frac{t_1\left(\underline{c}_1 - \bar{c}_1\right)}{1-(1-t_1)\,c_1 - b_1 + m_1}\Delta \bar{T}_0 > 0.
\end{aligned}$$

Finally, for the same reason as in the "twin deficits" case, an increase in output leads to a trade deficit because some of the additional demand of the low income falls on imported goods so that:

$$\begin{aligned}
\Delta NX &= -m_1 \Delta Y \\
\Delta NX &= -\frac{m_1\left(\underline{c}_1 - \bar{c}_1\right)}{1-(1-t_1)\,c_1 - b_1 + m_1}\Delta \bar{T}_0 < 0
\end{aligned}$$

In other words, we get a trade deficit but a budget surplus. As we shall see during the last lecture of the class, this situation corresponds very well to the U.S. case at the end of the 1990s.

Readings - To go further

Paul Krugman, "Trump's Twin Deficits (Wonkish)", *New York Times*, February 16, 2018.