Open Economy: Some Numerical Examples

Introducing Proportional Income Tax into Open Economy Model

In our discussion of open economy income determination, we have had the system:

$$Y = C + I + G + (X-M) \ldots \qquad \ldots \qquad \ldots \qquad 1)$$

Where $C = C(Yd) = a + b(Y-T)$, $M = M + m.Y$, and I, G, T, X are exogenously given.

In this system, the expression for equilibrium income is:

$$Y = (a-bT+I+G+X-M)/(1-b+m) \qquad \ldots \qquad \ldots \qquad 2)$$

And the foreign trade multiplier is given by:

$$\Delta Y/ \Delta X = 1/(1-b+m) \qquad \ldots \qquad \ldots \qquad \ldots \qquad 3)$$

In the above, taxes are assumed to be a lump-sum amount independent of income.

We now incorporate a proportional income tax into this system.

Thus, $T = T(Y) = T_0 + t.Y$, where T_0 = a constant tax, can be considered as a subsidy (negative tax) at lower income levels, and t is the proportional income tax rate.

Hence now, the mpc becomes b(1-t)

How?

$C = a + b. Y_d$

$= a + b. (Y - T_0 - t.Y)$

$= a - b.T_0 + b(1-t).Y$, so that now mpc = b. (1-t)

Check that the foreign trade multiplier now becomes

$\Delta Y / \Delta X = 1 / (1 - b(1-t) + m)$

In equilibrium, now,

$$Y = \text{(sum of autonomous expenditure components)} / (1mpc+mpm)$$
$$= (a-bT_0+I+G+X-M)/(1-b(1-t)+m) \quad \ldots \quad \ldots \quad 4)$$

And
$$\Delta Y/ \Delta X = 1/(1-b(1-t)+m) \quad \ldots \quad \ldots \quad 5)$$

Comparing this with the foreign trade multiplier with only lumpsum taxes, the multiplier is now *smaller.*

Examples:
1. Consider the following system:

$$C = 60 + 0.9 \, Yd$$
$$I = 10$$
$$G = 10$$
$$T = 0$$
$$X = 20$$
$$M = 10 + 0.05Y, \qquad \text{all values in money units.}$$

To find i) Equilibrium income, ii) Trade balance, iii) Value of foreign trade multiplier.

Numerical Examples

1. (To find i) Equilibrium income, ii) Trade balance, iii) Value of foreign trade multiplier), given

$$C = 60 + 0.9 \, Yd$$

$$I = 10, \quad G = 10, \quad T = 0$$

$$X = 20, \qquad M = 10 + 0.05Y$$

Solution:

i) National Income:

We have, equilibrium national income

$$Y = (a-b.T +I+G+X-M)/(1-b(1-t)+m) \quad \text{(Alternatively, you can use the equilibrium cond.)}$$

$$= (60+10+10+20-10)/(1-0.90+0.05)$$

$$= 90 \,/0.15 = 600$$

ii) Trade Balance: $X-M = X-(M_0 + m.Y) =(X- M_0)-m.Y = 20-10- 0.05Y$

$$= 10 – 0.05 \times 600 = -20 \rightarrow \text{The trade balance is in deficit. (What does this trade deficit imply regarding the S-I balance?)}$$

iii) Foreign Trade multiplier:

$$= 1/ (1-b(1-t) + m) = 1/ (1-0.90 + 0.05) = 6.66$$

Numericals- II

Consider the following economy:

$$C = 100 + b (Y-50-t.Y) \qquad\qquad (T + t.Y = 50 + 0.25 Y)$$
$$I = 50, G= 50,$$
$$X = 10, M = 5 + 0.1. Y$$

Given that, the marginal propensity to consume is 0.8, and the proportional income tax rate is 0.25.

Find i) equilibrium national income

    ii)   Foreign trade multiplier

    iii) Equilibrium value of imports

    iv) Suppose the government wants to raise equilibrium income by 50. By how much should government expenditure be increased?

Solution:

i)   We have, $Y = (a-b.T +I+G+X-M)/(1-b(1-t)+m)$

Substituting the values of the variables and parameters, we have:

$$Y = (100 -50\times0.8 + 50+50+10-5)/(1-0.8 (1-0.25)+0.1)$$
$$= 165 /0.5 = 330$$

ii) Foreign Trade Multiplier $= 1/(1-0.8\times(1-0.25)+0.1) = 2$

iii) Equilibrium value of imports.

Imports = 5 + 0.1Y

Y   =   330

hence,   imports = 5 + 0.01x 330 = 38 units

iv) By how much should G increase if income has to rise by 50?

Here, the government expenditure Multiplier = $\Delta Y/ \Delta G = 2.$
Hence,   for ΔY to be 50,

Required $\Delta G = \Delta Y/2 = 50/2 = 25$

Numerical Exercise: III

Consider the system of behavioural equations:

$$C = 40 + 0.80 \, Y_d$$

$$I = 60, \quad X = 40$$

$$M = 15 + 0.05Y$$

Find i) Equilibrium National Income, and Trade Balance.

ii) Suppose autonomous exports rise by 10. What will be the new income level and the trade balance?

Solution:

i) Here, taxes are absent, so that, $Y_d = Y$

$$Y_E = (a + I + X - M)/(1 - b + m)$$

Hence,

$$Y_E = (40 + 60 + 40 - 15) / (1 - 0.80 + 0.05)$$

$$= 125/4 = 500 \text{ money units.}$$

The Trade Balance:

$$X – M (Y)$$

$$= 40 -- (15 + 0.05 \times 500)$$

$$= 40-40 = 0 \quad \rightarrow \quad \text{Trade balance is balanced in}$$
equilibrium.

Increase in autonomous exports = 10.

➔ Income will rise by the amount $\Delta Y = k. \Delta X$

➔ Hence,

$$\Delta Y = 4 \times 10 = 40,$$

So that now the equilibrium income = $Y + \Delta Y = 500 + 40 = 540$.

Trade balance: $X – M$, where X is now 50, and $M = 15 + 0.05 \times 500$

$$X – M = 50 – (15 + 25) = 50-44 = 6$$

➔ Increase in exports has led to

        i)   Increase in national income by 40 units, and

        ii)   increase in trade balance by 6 units.