AN EXTENSION IN RELATIONS BETWEEN DOMESTIC ECONOMIC ACTIVITY AND INTERNATIONAL TRADE

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1. INTRODUCTION

In 1970 W.L. Smith, in chapter 22 of his book presented four cases about relations between domestic economic activity and international trade. But the model, which he used, was very simple, without government expenditures and taxes.

An extension of this model, with new equations, which includes the government expenditures and taxes would be of more scientific interest.

This is the cause I present this work. I will analyse only two of Smith's four cases, because the other two are based on the same idea.

2. THE MODEL

We consider a world in which there are two countries, which we shall call Country 1 and Country 2. For some purposes, it will be useful to think of Country 1 as the country we are primarily concerned with (say, Greece) and Country 2 as the rest of the world. The economies of these two countries are governed by the following set of equations :

$$C_1 = (1 - s_1) . Y_{1d} + \overline{C_1} \qquad (2.1)$$

$$M_1 = m_1 . Y_{1d} + \overline{M_1} \qquad (2.2)$$

$$Y_{1d} = Y_1 - T_1 \qquad (2.3)$$

$$T_1 = t_1 . Y_1 \qquad (2.4)$$

$$Y_1 = C_1 + I_1 + G_1 + (X_1 - M_1) \qquad (2.5)$$

$$C_2 = (1 - s_2) . Y_{2d} + \overline{C_2} \qquad (2.6)$$

$$M_2 = m_2 . Y_{2d} + \overline{M}_2 \qquad (2.7)$$

$$Y_{2d} = Y_2 - T_2 \qquad (2.8)$$

$$T_2 = t_2 . Y_2 \qquad (2.9)$$

$$Y_2 = C_2 + I_2 + G_2 + (X_2 - M_2) \qquad (2.10)$$

$$X_1 = M_2 \qquad (2.11)$$

$$X_2 = M_1 \qquad (2.12)$$

In these equations, subscript 1 refers to Country 1 and subscript 2 to Country 2 ; Y is national income (GNP), Yd is disposable income (personal), C is personal consumption expenditures, I is gross private domestic investment, G is government expenditures, X is exports of goods and services, and M is imports of good and services. Equations (2.1) and (2.6) are the consumption functions of Countries 1 and 2.

The parameters s_1 ans S_2 are the respective marginal propensities to save : m_1 and m_2 are the margimal propensities to import of the two countries and t_1

and t_2 are the marginal rates of tax. Equations (2.11) and (2.1) merely state the fact that in a two country system, the exports of one country are necessarily equal to the imports of the other.

In using system of equations, we are making several assumptions, partly to simplify the presentation and partly to isolate the effects of changes in income from other changes that might be occurring at the same time.

1. We are assuming that the exchange rate between the currencies of the two countries is rigidly fixed and also that internal prices [do not change in either country. In other words, we assume that in both countries there are unemployed productive factors, constant returns in production, and constant factor prices. Real consumption and real imports are taken to be functions of real income.

2. We are disregarding all monetary influences assuming, in effect, that interest rates remain unchanged in both countries.

3. Possible effects of the level of national income or of changes in national income on domestic investment are neglected.

4. No account is taken of elements in the balance of payments other than trade in goods and services.

In this model, investment in each country (I_1 and I_2) and government expenditures (G_1 and G_2) are taken to be exogenously determined. The parameters M_1, M_2, C_1, C_2, T_1 and T_2 reflect the level of import, consumption demand and taxes. The model contains twelve equations which are sufficient to determine the twelve variables, Y_1, Y_2, C_1, C_2, M_1, M_2, X_1, X_2, T_1, T_2 Y_{1d} and Y_2d.

3. FOREIGN TRADE MULTIPLIERS

From this model we will derive a set of foreign trade multipliers which show the effects on income in the two countries of autonomous changes in investment (I_1 and I_2) and of autonomous shifts in import demand (changes in M_1, and M_2).

The easiest way to begin the derivation of the foreign trade mulitpliers is to write equations 2.1 to 2.12 in rerms of changes ;

$$\Delta C_1 = (1 - s_1) . \Delta Y_{1d} + \overline{\Delta C_1} \quad (3.1)$$

$$\Delta M_1 = m_1 . \Delta Y_{1d} + \overline{\Delta M_1} \quad (3.2)$$

$$\Delta Y_1 = \Delta C_1 + \Delta I_1 + \Delta G_1 + \Delta X_1 - \Delta M_1 \quad (3.3)$$

$$\Delta Y_{1d} = \Delta Y_1 - \Delta T_1 \quad (3.4)$$

$$\Delta T_1 = t_1 . \Delta Y_1 \quad (3.5)$$

$$\Delta C_2 = (1 - s_2) . \Delta Y_{2d} + \overline{\Delta C_2} \quad (3.6)$$

$$\Delta M_2 = m_2 . \Delta Y_{2d} + \overline{\Delta M_2} \quad (3.7)$$

$$\Delta Y_{2d} = \Delta C_2 + \Delta I_2 + \Delta G_2 \ \Delta X_2 - \Delta M_2 \quad (3.8)$$

$$\Delta Y_{2d} = \Delta Y_2 - \Delta T_2 \quad (3.9)$$

$$\Delta T_2 = t_2 . \Delta Y_2 \quad (3.10)$$

$$\Delta X_1 = \Delta M_2 \quad (3.11)$$

$$\Delta X_2 = \Delta M_1 \quad (3.12)$$

We can use equations (3.11) and (3.12) as a basis for substituting ΔM_2 for ΔX_1 in equation (3.3) and ΔM_1 for ΔX_2 in equation (3.8). Then equattions (3.3) and (3.8) become.

$$\Delta Y_1 = \Delta C_1 + \Delta I_1 + \Delta G_1 + \Delta M_2 - \Delta M_1 \quad (3.13)$$

$$\Delta Y_2 = \Delta C_2 + \Delta I_2 + \Delta G_2 + \Delta M_1 - \Delta M_2 \quad (3.14)$$

Substituting in these equations the values of ΔC_1, ΔM_1, ΔC_2, $\Delta M2$ given by equations (3.1), (3.2), (3.6) and (3.7) and the value ΔY_{1d}, ΔT_1, $-\Delta Y_{2d}\Delta T_2$, given by equations (3.4), (3.5), (3.9) and (3.10), we obtain, after some simplification.

$$[t_1+(s_1+m_1)(1-t_1)].\Delta Y_1=\overline{\Delta C_1}+\overline{\Delta I_1}+\overline{\Delta G_1}+m_2.(1-t_2).\Delta Y_2+\overline{\Delta M_2}-\overline{\Delta M_1} \quad (3.15)$$

$$[t_2+(s_2+m_2)(1-t_2)].\Delta Y_2=\overline{\Delta C_2}+\overline{\Delta I_2}+\overline{\Delta G_2}+m_1.(1-t_1).\Delta Y_1+\overline{\Delta M_1}-\overline{\Delta M_2} \quad (3.16)$$

From these equations, we can readily derive the multipliers we are interested in.

CASE 1 :

Multipliers applicable to an autonomous change in domestic investment in Country 1 (ΔI_1).

In this case, we assume that everything in equations (3.15) and (3.16) except investment in country 1, income in country 1 and income in country 2 remains constant. Thus $\overline{\Delta C_1}=0$, $\overline{\Delta M_1}=0$, $\overline{\Delta C_2}=0$, $\overline{\Delta I_2}=0$, $\overline{\Delta G_1}=0$ and $\overline{\Delta G_2}=0$.

Equations (3.15) and (3.16) become

$$[t_1+(s_1+m_1)(1-t_1)].\Delta Y_1=\Delta I_1+m_2.(1-t_2)\ \Delta Y_2$$

$$[t_2+(s_2+m_2)(1-t_2)].\Delta Y_2=m_1.(1-t_1).\Delta Y_1$$

Solving the second of these equations for ΛY2,, we obtain

$$\Delta Y_2=\frac{m_1.(1-t_1)}{t_2+(s_2+m_2)(1-t_2)}.\Delta Y_1 \quad (3.17)$$

Substituting this into the first of the equations, we obtain,

$$\left\{ t_1 + (s_1 + m_1)(1 - t^1) \right\} . \Delta Y_1 = \Delta I_1 + m_2 (1 - t_2) \frac{m_1 (1 - t_1)}{t_2 + (s_2 + m_2)(1 - t_2)} . \Delta Y_1$$

Solving for ΔY_1, we have

$$\Delta Y_1 = \frac{t_2 + (s_2 + m_2)(1 - t_2)}{[t_1 + (s_1 + m_1)(1 - t_1)][t_2 + (s_2 + m_2)(1 - t_2)] - m_1 m_2 (1 - t_1)(1 - t_2)} . \Delta I_1 \quad (3,18)$$

Substituting this value for ΔY_1 in equation (3.17) and solving for ΔY_2,we obtain

$$\Delta Y_2 = \frac{m_1 . (1 - t_1)}{t_2 + (s_2 + m_2)(1 - t_2)} . \frac{1}{\left\{ t_1 + (s_1 + m_1)(1 - t_1) - \frac{m_1 m_2 (1 - t_1)(1 - t_2)}{t_2 + (s_2 + m_2)(1 - t_2)} \right\}} . \Delta I_1$$

or

$$\Delta Y_2 = \frac{m_1 . (1 - t_1)}{[t_1 + (s_1 + m_1)(1 - t_1)][t_2 + (s_2 + m_2)(1 - t_2)] - m_1 m_2 (1 - t_1)(1 - t_2)} . \Delta I_1 \quad (3.19)$$

The trade balance of Country 1 (B_1) is the difference between Country l's exports and that its imports is $B_1 = X_1 - M_1$. Thus, the change in its trade balance is

$$\Delta B_1 = \Delta X_1 - \Delta M_1 = \Delta M_2 - \Delta M_1 .$$

or

$$\Delta B_1 = m_2 (1 - t_2) . \Delta Y_2 - nu (1 - t_1) . \Delta Y_1$$

Substituting the values of ΔY_1, and ΔY_2, from equations (3,18) and (3.19) and simplifying, we have

$$\Delta B_1 = \frac{m_1 m_2 (1-t_1)(1-t_2)}{[t_1+(s_1+m_1)(1-t_1)][t_2+(s_2+m_2)(1-t_2)] - m_1 m_2 (1-t_1)(1-t_2)} \cdot \overline{\Delta I_1} -$$

$$- \frac{m_1 (1-t_1)[t_2+(s_2+m_2)(1-t_2)]}{[t_1+(s_1+m_1)(1-t_1)][t_2+(s_2+m_2)(1-t_2)] - m_1 m_2 (1-t_1)(1-t_2)} \cdot \overline{\Delta I_1}$$

or

$$\Delta B_1 = \frac{m_1 m_2 (1-t_1)(1-t_2) - m_1 (1-t_1)[t_2+(s_2+m_2)(1-t_2)]}{[t_1+(s_1+m_1)(1-t_1)][t_2+(s_2+m_2)(1-t_2)] - m_1 m_2 (1-t_1)(1-t_2)} \cdot \overline{\Delta I_1} \quad (3.20)$$

The change in the trade balance of Country 2, $\Delta B2$ is the same as the change in the trade balance of country 1, but with opposite sign.

CASE 2.

Multipliers applicable to an autonomous change in the demand for imports in Country 2 ($\Delta M2$)

This is the same thing as an autonomous in Country 1' s exports. Its effects can be derived by setting $\Delta C_1 = 0$, $\Delta \ddot{I}_1 = 0$. ~$\Delta M_1 = 0$, ~$\Delta C_2 = 0$ ~$\Delta I_2 = 0$, ~ΔG_1=o and $\Delta G_2 = 0$ in equations (3.15) and (3.16) and solving the resulting equations for ΔY_1 and $\Delta Y2$. This yields

$$[t_1 + (s_1 + m_1)(1 - t_1)] . \Delta Y_1 = \overline{\Delta M}_2 + m_2 (1 - t_2) . \Delta Y_2) \tag{3.21}$$

$$[t_2 + (s_2 + m_2)(1 - t_2)] . \Delta Y . (1 - t_1) . \Delta Y_1 - \overline{\Delta M}_2 \tag{3.22}$$

or

$$\Delta Y_1 = \frac{1 - \dfrac{m_2 (1 - t_2)}{t_2 + (s_2 + m_2)(1 - t_2)}}{t_1 + (s_1 + m_1)(1 - t_1) - \dfrac{m_1 m_2 (1 - t_1)(1 - t_2)}{t_2 + (s_2 + m_2)(1 - t_2)}} . \overline{\Delta M}_2$$

$$\Delta Y_1 = \frac{t_2 + (s_2 + m_2)(1 - t_2) - m_2 (1 - t_2)}{[t_1 + (s_1 + m_1)(1 - t_1)][t_2 + (s_2 + m_2)(1 - t_2)][m_1 m_2 (1 - t_1)(1 - t_2)} . \overline{\Delta M}_2 \tag{3.23}$$

and

$$\Delta Y_2 = \frac{m_1 (1 - t_1)}{t_2 + (s_2 + m_2)(1 - t_2)} .$$

$$. \frac{[t_2 + (s_2 + m_2)(1 - t_2)] - m_2 (1 - t_2)}{[t_1 + (s_1 + m_1)(1 - t_1)][t_2 + (s_2 + m_2)(1 - t_2)] - m_1 m_2 (1 - t_1)(1 - t_2)} . \overline{\Delta M}_2 -$$

$$- \frac{1}{t_2 + (s_2 + m_2)(1 - t_2)} . \overline{\Delta M}_2$$

or

$$\Delta Y_2 = \frac{\overline{\Delta M}_2}{t_2+(s_2+m_2)(1-t_2)} \left\{ \frac{m_1(1-t_1)[t_2+(s_2+m_2)(1-t_2)]-m_1m_2(1-t_1)(1-t_2)}{[t_1+(s_1+m_1)(1-t_2)][t_2+(s_2+m_2)(1-t_2)-m_1m_2(1-t_2)} - 1 \right\}$$

or

$$\Delta Y_2 = \frac{m_1(1-t_1)-[t_1+(s_1+m_1)(1-t_1)}{[t_1+(s_1+m_1)(1-t_1)][t_2+(s_2+m_2)(1-t_2)]-m_1m_2)(1-t_1)(1-t_2)} \cdot \overline{\Delta M}_2 \qquad (3.24)$$

The effect on Country Γ s trade balance is given by

$\Delta B_1 = \Delta X_1 - \Delta M_1 = \Delta M_2 - AM_1 = m_2(1\sim t2).AY2 + \Delta M2 - m_1(1-t_1) . \Delta Y_1$

Substituting the values of ΔY_1 and ΔY_2 from equations (3.23) and (3.24) we have

$$\Delta B_1 = \overline{\Delta M}_2 \left[1 + \frac{m_2(1-t_2)}{t_2+(s_2+m_2)(1-t_2)} \cdot \left\{ \right. \right.$$

$$\left. \frac{m_1(1-t_1)[t_2+(s_2+m_2)(1-t_2)]-m_1m_2(1-t_1)(1-t_2)}{[t_1+s_1(s_1+m_1)(1-t_1)][t_2+m_2)(1-t_2)]-m_1m_2(1-t_1)(1-t^2)} - 1 \right\} - m_1(1-t_1) \cdot$$

$$\left. \frac{[t_2+(s_2+m_2)(1-t_2)-m_2(1-t_2)}{[t_1+(s_1+m_1)(1-t_1)][t_2+(s_2+m_2)(1-t_2)]-m_1m_2(1-t_1)(I-t_2)} \right]$$

$$\Delta B_1 = \frac{[t_1+(s_1+m_1)(1-t_1)][t_2+(s_2+m_2)(1-t_2)]+m_1m_2(1-t_1)(1-t_2)-m_2.(1-t_2).}{[t_1+(s_1+m_1)(1-t_1)][t_2+(s_2+m_2)(1-t_2)]-(m_1m_2(1-t_1)(1-t_2)}$$

$$[t_1+(s_1+m_1)(1-t_1)+$$

$$+\frac{-m_1(1-t_1).[t_2+(s_2+m_2)(1-t_2)}{[t_1+(s_1+m_1)(1-t_1)][t_2+(s_2+m_2)(1-t_2)]-m_1m_2(1-t_1)(1-t_2)}.\overline{\Delta M_2}$$

Now, if we put

$$t_1+(s_1+m_1)(1-t_1) = A$$

$$ta+(s_2+m_2)(1-t_2) = B \quad (3.26)$$

$$m_1(1-t_1) = C$$

$$m_2(1-1_2) = D$$

we have

For case 1 :

Multipliers applicable to an autonomous change in domestic investment in country 1 (ΔI_1).

The types (3.18), (3.19) and (3.20) become,

$$\Delta Y_1 - \frac{B}{A.B-C.D}.\overline{\Delta I_1} \quad (3.27)$$

$$\Delta Y_2 — \frac{C}{A.B.—C.D} . \overline{\Delta I_1} \tag{3.28}$$

$$\Delta B_1 — \frac{C(D - B)}{A.B — C.D} . \overline{\Delta I_1} \tag{3.29}$$

For case 2 :

Multipliers applicable to an autonomous change in the demand for imports in Country 2 (ΔM2)

The types (3,23), (3.24) and (3,25) become,

$$\Delta Y_1 = \frac{B — D}{A.B — C.D.} . \overline{\Delta M_2} \tag{3,30}$$

$$\Delta Y_2 = \frac{C — A}{A.B — C.D.} . \overline{\Delta M_2} \tag{3.31}$$

$$\Delta B_1 = \frac{(A — C)(B — D)}{A.B. — C.D} . \overline{\Delta M_2} \tag{3.32}$$

4. REFERENCES

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