GROWTH, DISTRIBUTION AND INTERNATIONAL TRADE IN CAPITAL GOODS

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Abstract

Starting in 1977 Steedman, Metcalfe and others launched critique of the standard trade theory in the context of the Sraffa, critique of the neoclassical theory of value and distribution. The main contention of this critique is that standard theorem of the Heckscher-Ohlin-Samuelson tradition will fail to hold in a world where capital goods are produced and a positive rate of profit is paid on the value of capital goods used in the production of goods. The effect of mutually gainful trade in capital goods on the prices and outputs of commodities as well as on the distributional variables and growth rates have been illustrated. Specifically, it is shown that international trade in capital goods has the effect of lowering the costs of production in the trading countries and consequently has the effect of increasing the rates of profit and growth.

Section I

Introduction

Trade of capital goods between countries introduces a special complication from the theoretical standpoint viz. the pre-trade production possibility frontiers of the countries cease to hold in the post-trade situation. Access to cheaper capital goods inevitably shifts the production possibility frontiers outwards. Simultaneously, access to cheaper capital goods shifts the wage- profit frontier and its dual the consumption-growth frontier outwards. It is expected that these effects of trade in capital goods will have consequences not only for the production levels but also for income distribution, growth and prices in the trading countries. The purpose of this paper is to investigate these consequences in detail.

The motivation for this paper has its roots in a strand of literature initiated by Steedman et. al. (1979) which called attention to the vulnerability of neoclassical trade theory to the fundamental issues raised by the capital controversies of the 1960's. For reasons that are partly known but largely unknown [e.g. Smith (1982)] their critique did not quite catch on; mainstream trade theory continued to progress in the belief that it had resolved all the complications that the presence of intermediate (or even fixed) capital goods poses for the theories of value and trade. However static neoclassical trade theory does have a formal place for intermediate goods but not intermediate goods in their role as constituents of the value of the capital stock on which a rate of profit is earned. But this is precisely the treatment that is required to bring out

interrelationships between trade and the process of capital accumulation, growth, income distribution and production.

This paper is no more than a first step in that direction. The paper investigates the properties of a simple model containing two capital goods and one non-tradable consumption good. The paper is organized in three sections. The first section shows how equilibrium in autarky is determined. The second section allows two countries to trade based on the pattern of comparative advantages and shows how the world trade equilibrium is determined. The third section concludes with remarks on the properties of the world trade equilibrium.

Section II

Autarkic Equilibrium

Consider an economy which produces three goods by means of a fixed coefficients constant returns to scale technology. Of the three commodities, two are purely capital goods and the third is purely a consumption good. It is supposed that profits are wholly accumulated and wages are wholly consumed. Also suppose that the money wage rate is exogenously given. Then the following equations describe the price determination of the tree goods and demand equations for the consumption good.

$$\begin{aligned}
(A_{11}\,p_1 + A_{21}\,p_2)(1+r) + wL_1 &= B_1P_1 \\
(A_{12}\,p_1 + A_{22}\,p_2)(1+r) + wL_2 &= B_2P_2 \\
(A_{13}\,p_1 + A_{23}\,p_2)(1+r) + wL_3 &= B_3P_3 \\
wL &= B_3P_3
\end{aligned} \qquad \ldots(1)$$

The unknowns whose values in equilibrium are to be determined are the three prices, the rate of profit, the rate of growth and the outputs of the three commodities, i.e. 7 unknowns in all of course in view of the classical assumption that wages are wholly consumed and profits are wholly saved so that the equilibrium rate of growth will be equal to the equilibrium rate of profit. By equilibrium will be meant that demands and supplies of all the three goods must be equal to one another. The demand-supply equation for the consumption good is the fourth equation of (1). The demand-supply equations for the capital goods appear in the dual of the system (1) which will be written as,

$$\begin{aligned} &\left(A_{11}x_1 + A_{12}x_2 + A_{13}\right)(1+g) = B_1x_1 \\ &\left(A_{21}x_1 + A_{22}x_2 + A_{23}\right)(1+g) = B_2x_2 \\ &L_1x_1 + L_2x_2 = L_1 + L_2 = L_k \end{aligned} \qquad \ldots (2)$$

The left hand sides of the first two equations are the demands for the two capital goods and the right hand sides are the supplies; the left hand side shows the replacement and new investment demands (at a uniform growth rate) for the capital goods from all the three industries in the economy which must be satisfied by the supplies of those goods shown on right hand side. The last equation of (2) is the full-employment condition which must be read as $L_1x_1 + L_2x_2 + L_3 = L_1 + L_2 + L_3$ implying $L_1x_1 + L_2x_2 = L_1 + L_2 = L_k$ where L_k is total employment in the two capital goods industries. The system (2) solves for the rate of growth (equal to the rate of profit) and the two scale intensities x_1

and x_2. Multiplying the first two equations of (1) by x_1 and x_2 and writing $r = g$ the system of equation gives the equilibrium of the economic system.

$$\begin{gathered}\left(A_{11}x_1p_1 + A_{21}x_1p_2\right)(1+r) + wL_1x_1 = B_1x_1p_1 \\ \left(A_{12}x_2p_1 + A_{22}x_2p_2\right)(1+r) + wL_2x_2 = B_2x_2p_2 \\ \left(A_{13}p_1 + A_{23}p_2\right)(1+r) + wL_3 = B_3p_3\end{gathered} \quad \ldots (3)$$

When the solution of rate of profit is substituted in (3) it solves for the prices p_1, p_2 and p_3. It can be easily shown that the quantity demanded of commodity 3, B_{3d} at the price solution p_3 in equation (3) is exactly equal to the quantity supplied B_3 in equation (1). From the fourth equation of (1)

$$B_{3d} = \frac{wL}{p_3} = \frac{(A_{13}p_1 + A_{23}p_2)(1+r) + wL_3}{p_3} = B_3$$

because $w(L_1 + L_2) = (A_{13}p_1 + A_{23}p_2)(1+r)$

where, $w(L_1 + L_2)$ is value of exports of industry 3 to the capital goods industries and $(A_{13}p_1 + A_{23}p_2)(1+r)$ is the value of its imports (replacement plus new investment) from them. Thus the equality of the demand and supply of the consumption is attained at every arbitrary supply level of the consumption good B_3. It is immediately pointed out that this is not a general property; it is a property of as economic system that contains several capital goods but only one consumption good.

Section III

Trade Equilibrium

Next we shall consider two economies A and B which produce all the three commodities. Suppose the wage rates for country A and B are W_A=¥1 and W_B =$1 respectively. The labour endowments in country A and country B are L_A=12 and L_B=14 units respectively.

The autarky equilibria, ascertained by the method outlined in section I are shown in Table1. The rates of profits and prices in autarkic equilibrium are shown in Table 2.

Table 1

A	B
1 $(2P_{1A}+3P_{2A})(1+r_A)+1W_A=27P_{1A}$	$(3.375P_{1B}+13.166P_{2B})(1+r_B)+9W_B=16.2P_{1B}$
2 $(9P_{1A}+5.5P_{2A})(1+r_A)+10W_A=26.25P_{2A}$	$(1P_{1B}+1.5P_{2B})(1+r_B)+1W_B=48P_{2B}$
3 $(7P_{1A}+9P_{2A})(1+r_A)+1W_A=20P_{3A}$	$(4.625P_{1B}+12P_{2B})(1+r_B)+4W_B=20P_{3B}$

The rates of profits and prices in country A and country B are;

Table 2

Country A	Country B
$r_A=0.5$ $P_{1A}=¥0.1696$ $P_{2A}=¥0.6828$ $P_{3A}=¥0.6$	$r_B=0.8$ $P_{1B}=\$1.0370$ $P_{2B}=\$0.0632$ $P_{3B}=\$0.7$

The pattern of comparative advantages for the tradable goods 1 and 2 can be obtained from the prices;

$$\frac{P_{1A}}{P_{2A}} = 0.2485 \; < \; \frac{P_{1B}}{P_{2B}} = 16.3874$$

This condition may also be equivalently stated in exchange rate units,

$$\frac{P_{1A}}{P_{1B}} = 0.1636 \; < \; \frac{P_{2A}}{P_{2B}} = 10.7904$$

If we allow A to specialize in the production of commodity 1 and B to specialize in the production of commodity 2 then industries 1and 2 in countries B and A respectively will cease to operate and the price equations in the two countries would be as shown in Table 3.

Table 3

A	B
1 $(2P_{1A} + 3P_{2B}E_{AB})(1 + r_A) + 1W_A = 27P_{1A}$	.....
2.....	$(1P_{1B}E_{BA} + 1.5P_{2B})(1 + r_B) + 1W_B = 48P_{21B}$
3 $(7P_{1A} + 9P_{2B}E_{AB})(1 + r_A) + 1W_A = 20P_{3A}$	$(4.625P_{1A}E_{BA} + 12P_{2B})(1 + r_B) + 4W_B = 20P_{3B}$

Observe that the price equations of the industries have been expressed in terms of the own currencies of the countries. Thus the yen-dollar exchange rate E_{AB} has been attached to the price of commodity 2 which is imported by country A and dollar-yen rate E_{BA} has been attached to the price of commodity 1 which is imported by country B.

To find whether the above configuration of activities is an international trade equilibrium, we set up the world demand-supply equations for the commodities; for the two tradable capital goods the sources of demands are domestic and foreign, whereas for the non tradable consumption good the demand is only domestic. There are primarily 13 unknowns to be determined including 4 post-trade outputs, 4 post-trade prices, 2 post-trade rates of growth, 2 post- trade rates of profit and the exchange rate (or terms of trade). Of these for reasons mentioned in section I, the post-trade outputs of the (non-tradable) consumption good will not need determination; they will be equal to the autarky levels. Also due to the classical assumption that profits are accumulated and wages are consumed each country's growth rate will equal its profit rate. Thus, 4 unknowns are eliminated so that 9 remain to be determined. As regards the equations there will firstly be two world demand-supply equations for the capital goods 4(a) which simply state that outputs of capital goods 1 and 2 from countries A and B must be such as to satisfy the replacement and new investment demands of all industries in both the countries. These are supplemented by the full-employment conditions in 4(b) in the two countries.

$$\frac{x_{1A}L_{1A}}{l_{1A}} = (\frac{a_{11A}x_{1A}L_{1A}}{l_{1A}} + \frac{a_{13A}x_{3A}L_{3A}}{l_{3A}})(1+g_A) + (\frac{a_{12B}x_{2B}L_{2B}}{l_{2B}} + \frac{a_{13B}x_{3B}L_{3B}}{l_{3B}})(1+g_B)$$

$$\frac{x_{2B}L_{2B}}{l_{2B}} = (\frac{a_{21A}x_{1A}L_{1A}}{l_{1A}} + \frac{a_{31A}x_{3A}L_{3A}}{l_{3A}})(1+g_A) + (\frac{a_{22B}x_{2B}L_{2B}}{l_{2B}} + \frac{a_{32B}x_{3B}L_{3B}}{l_{3B}})(1+g_B)$$

… 4(a)

$$x_{1A}L_{1A} + x_{3A}L_{3A} = L_A$$
$$x_{2B}L_{2B} + x_{3B}L_{3B} = L_B$$

… 4(b)

For reason stated above $x_{3A} = x_{3B} = 1$ so that the system (4) will have 4 equations in 4 unknowns. Their solution is $x_{1A} = 11 and\ x_{2B} = 10$, $g_A = r_A = 4.92$, $g_B = r_B = 7.5688$. At this stage we have determined the post-trade levels of outputs and the growth/profit rates in the two economies. We must now determine the prices of commodities and the exchange rate. To determine these there are two price equations in table 2, that for capital good 1 in country A and for capital good 2 in country B. Besides, there is one equation to determine the exchange rate.The equilibrium exchange rate E_{AB} must be such as to balance the trade. Considering that $E_{AB} = 1/E_{BA}$ we may write the trade balancing exchange rate as follows,

$$E_{AB} = \frac{x_{2B}P_{1A}(1+r_B) + 4.625x_{3B}P_{1A}(1+r_B)}{3x_{1A}P_{2B}(1+r_A) + 9x_{3A}P_{2B}(1+r_A)} \quad \ldots (5)$$

where the numerator shows the imports of country B in terms of yen and the denominator shows the exports of country B in dollars.

Now observe the circularity; until the prices P_{1A} and P_{2B} are determined we cannot ascertain the exchange rate. But the prices P_{1A} and P_{2B} which are in yen and dollars respectively cannot be determined until the exchange rate is determined. However we have the required number of equations viz. the post-trade price equations for the two capital goods appearing in table 3 and the exchange rate equation (5) above. So the only way to resolve the circularity is to proceed iteratively. Thus substitute initially the autarky prices P_{1A} and P_{2B} in (5) and solve E_{AB}. Next substitute E_{AB} in the price equations of capital goods in Table 3 to find out P_{1A} and P_{2B} corresponding to it and substitute the solution in (5) to obtain a revised value of E_{AB} and so on until the result

converge. Table 4 below shows the convergence to an accuracy of up to 4 places of decimals in 7 iterations.

Table 4

Iteration No.	P_{1A}	P_{2B}	E_{AB}
1.	0.1696970	0.06328054	1.351616
2.	0.1600593	0.0553372	1.457851
3.	0.1609443	0.0551371	1.471232
4.	0.1610065	0.0551232	1.472171
5.	0.1610246	0.05511923	1.472443
6.	0.1610373	0.0551164	1.472468
7.	0.1610368	0.0551158	1.472477

This completes determination of 7 of the 9 unknowns. Finally given the solution the capital goods prices and the exchange rate the prices of the non-tradable consumption good in each country can be determined from respective price equations in table 3. Of course since the demand prices of the goods are known in advance $\left(\frac{wL_A}{B_{3A}}, \frac{wL_B}{B_{3B}}\right)$ this last step only verifies that the cost of production of the post-trade capital goods' prices and rates of profit i.e. supply prices equal the demand prices. Since the exchange rate $E_{AB} = 1.4725$ lies between the limiting value of 0.163 and 10.790 both countries will gain from trade. In other words, the ratio of commodity exchange (terms of trade) viz. 6.2111 units of commodity

1=26.4360 units of commodity 2 or 4.2562 lies between the limiting values of 0.2485 and 6.387. This may be verified from the table below, which shows the quantities of commodity 1 and 2 that can be obtained for ¥1 at home and abroad at the going international prices and the exchange rate.

Table 5

	Country A	Country B
Capital good 1	6.21118*	0.65488
Capital good 2	1.46455	26.43606*

Accordingly the world trade equilibrium may be written as shown in Table 6.

Table 6

A	B
1 $(22P_{1A}+33P_{2B}E_{AB})(1+r_A)+11W_A=297P_{1A}$	.....
2.....	$(10P_{1A}E_{BA}+15P_{2B})(1+r_B)+10W_B=480P_{2B}$
3 $(7P_{1A}+9P_{2B}E_{AB})(1+r_A)+1W_A=20P_{3A}$	$(4.625P_{1A}E_{BA}+12P_{2B})(1+r_B)+4W_B=20P_{3B}$

Some observations that are apparent from a comparison of the autarky and post-trade situations may be summarized as follows.

Table 7

	Pre-trade	Post-trade	Pre-trade	Post-trade
P_1	0.1696	0.1610	1.037	……
P_2	0.6828	……..	0.0632	0.0554
P_3	0.6	0.6	0.7	0.7
B_1	27	297	16.2	……..
B_2	26.25	……	48	480
B_3	20	20	20	20
w/P_3	1.6667	1.667322	1.4287	1.4287
g	0.5	4.92	0.8	7.5683
r	0.5	4.92	0.8	7.5683

Table 7 shows at a glance the general consequences of trade in the (simplistic) situation of our example. The post-trade prices of the capital goods have declined in both countries, the world outputs of capital goods have increased, the rates of growth and profit have risen but the prices of the consumption good and consequently the real wage rate have remained unaltered. It should immediately be pointed out that this last observation is not a general conclusion; it holds exclusively for a model with a single consumption good. In general case the real wage rates too increase.

Section IV

Concluding Remarks

(i) Firstly, while handling trade in capital goods the distinction between value capital and capital goods has been strictly maintained with profits being charged on the value of capital invested and the capital goods having their individual market prices. Specifically, the rate of profit is not treated as a return on “physical capital”. It would appear that this treatment of capital goods, capital and profits exactly fulfils the requirements that Steedman et.al. would expect from their critique of trade theory in the context of the capital controversy.

(ii) Secondly, it should be pointed out that the assumptions of model not guarantee the existence of a world trade equilibrium. If, for instance, if the labour endowments had been 10 and 15 in country A and country B respectively then the trade equilibrium would not exist.

(iii) Gainful trade of capital goods between the countries is found to raise the rates of growth, rates of profit. That the post-trade real wage rate remains unaltered should not be taken as a general conclusion; it is a property of a model which has only one consumption good. In the general case we should expect the real wage rates to rise. Access to international trade is akin to an access to a powerful technology that shifts outwards the wage-profit frontiers of both the countries.

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