Economica (2003) **70**, 551–566

Trade in Intermediate Goods in a Model with Monopolistic Competition

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Final version received 12 June 2001.

A model of trade in intermediate and final goods is developed incorporating the features of increasing returns and monopolistic competition. It is shown that the endowment basis (comparative advantage) for trade becomes crucial in determining trade across stages of production, with the capital-rich country a net exporter of specialized intermediate inputs and an importer of the final good. The capital-rich country is shown to be immune to distributional conflicts, whereas for the labour-rich country the distributional conflict crucially hinges upon the elasticity of substitution between intermediate inputs. Thus, free trade has inherently asymmetric effects on the functional distribution of income for countries differing in labour–capital ratios.

INTRODUCTION

Trade in intermediate goods comprises a large bulk in the volume of world trade (nearly 50%: Markusen 1989). A large body of empirical research has validated the claim that much of the world trade is informed by a pattern in which the capital-rich countries export specialized intermediate inputs to labour-rich countries and import back final goods. Such a pattern is observed in trade between the high-income countries of the European Community and the Mediterranean nations and between Japan and the developing nations in Asia. The newly industrializing countries (NICs) in East Asia rely heavily on imports of sophisticated intermediate inputs from the developed countries (DCs) in order to produce their final goods for export (Chang and Kim 1989).

Many of the intermediate manufactures that enter into international trade are probably characterized by significant degrees of scale economies and product differentiation. Factor intensity data suggest that intermediate manufactures are on average significantly more capital-intensive than final goods (Markusen and Melvin 1984). Capital intensity in turn suggests strong scale economies in that capital is required at an initial stage in developing the product and in setting up the plant to begin production. Subsequently the product can be provided at a low marginal cost.

The purpose of this paper is essentially twofold. First, I attempt to formalize the pattern of trade in intermediate goods and final goods, the empirics of which has been sketched out above. Essentially, I show that the capital-rich country is a net exporter of the capital-intensive intermediate goods and an importer of the final good. This explains the kind of trade mentioned above (between the NICs in East Asia and the developed countries, etc.).

Second, I deduce the distributional consequence of such trade in the model. In particular, I show that the trading partners are asymmetrically exposed to the distributional conflict following an opening-up to trade. In this context I

explore how countries differing in endowment ratios share in the total world gain following trade and also in the distribution of such gains within the country.

These results need a little more elaboration. And this is best done by positing the results in the context of the existing literature.

The issue of trade patterns across stages of production has been dealt with in the literature fairly well, but the emphasis has been mostly on competitive markets and constant returns to scale (CRS) technology. The earliest formalization was rendered by Sanyal and Jones (1982). In this paper an interesting combination of specific factors and factor endowment models is proposed to account for trade in intermediate goods (what the authors call middle products).

Findlay (1978), Dixit and Grossman (1982), Sanyal (1983), Sarkar (1985) and Marjit (1987) are other important contributions toward formalizing intermediate goods trade. Sarkar builds up a model of a time-phased flow input–point output economy, to show that the high-rental (capital-scarce) country will specialize in the earlier stages of the production spectrum and the low-rental (capital-rich) country will specialize in the later ones, and in that sense the capital-rich countries will be doing the final processing activity.

There is a point of discomfort about such predicted patterns of trade. Even casual empiricism would have us believe that the pattern of trade in intermediates has changed dramatically in recent times. It is now the capital-rich countries that are found to be exporting intermediate goods, and this is in accordance with the Heckscher–Ohlin (H–O) prediction, in the sense that intermediate goods are extremely capital-intensive now. On the other hand, the labour-rich countries are found to be specializing in the final assembly activity. Our model attempts to formalize such pattern of trade.

Models incorporating the features of scale economies set up in a monopolistically competitive market structure have been used extensively to formalize the idea of largely evident intra-industry trade in differentiated final or intermediate goods between similar countries. Krugman (1981) uses such a model to explore the consequences of international trade on income distribution; Ethier (1982) is yet another important paper along this line. Whereas Krugman develops a model with differentiated final goods, Ethier's model has differentiated intermediate inputs.

Here I build up a model along the lines proposed by Ethier and Krugman, incorporating the features of scale economies and monopolistic competition. The results in this paper demonstrate that allowing for trade in both final and intermediate goods leads to a trade pattern that reveals both the features of comparative advantage and increasing returns to scale. The model sharply brings into focus the forces of comparative advantage as a determinant of trade across stages of production. It is shown that the capital-rich country is the net exporter of specialized intermediate inputs and importer of the final good: a pattern of trade that mimics an empirically valid situation.

The second purpose of the paper, and closely related to the first, is to investigate the distributional (functional distribution) impact of trade as described above. In fact, a crucial aspect of Krugman's (1981) paper was to relate the pattern of trade to distributional conflict. Ethier (1982) also addresses the question of price shift and its distributional effects. Fischer and

Serra (1996) is yet another paper in which the question of trade and income inequality has been dealt in a median voter model embedded in a structure similar to Krugman's.

In this paper I show that the capital-rich country is immune to any distributional conflict irrespective of the strength of the scale economies, whereas the labour-rich country is shown to be susceptible to the same—susceptible in the sense that even if the scale economies might ultimately mitigate such conflict, it remains as a possibility.

In this context one might recall the result to be found in Krugman (1981). In his paper it is shown that the distributional conflict hinges crucially upon the exact pattern of trade, which in turn is related to the extent of the difference of factor endowment ratios. It is shown that, with countries differing substantially in endowment ratios, the dominant trade pattern is of inter-industry nature. With countries becoming similar endowment-wise, intra-industry trade based on increasing returns to scale (IRS) starts to dominate. It is further shown that with pronounced endowment differences the usual Stolper–Samuelson kind of distributional conflict prevails in both the countries. As countries become similar and thereby intra-industry trade starts to dominate, the Stolper–Samuelson type of conflict is erased.

Ethier (1982) is yet another paper in which the validity of the Stolper–Samuelson theorem has been checked in a model where one of the sectors is subject to IRS. Ethier shows that if the extent of scale economies are not very significant, the Stolper–Samuelson theorem remains valid.

The important point to be noted in this context is that both the countries are exposed to the same pattern of distributional conflict, which can be erased if the extent of intra-industry trade and/or scale economies are significant enough. Our paper departs from Krugman (1981) and Ethier (1982) in showing that countries are asymmetrically exposed to the distributional conflict, in that the capital-rich country (net exporter of intermediate goods) is immune to any distributional conflict irrespective of the extent of the scale economy. On the other hand, the labour-rich country can be exposed to a distributional conflict, which of course can be avoided if the scale economies are substantial and/or countries are similar enough.

Specifically, it is shown that in the capital-rich country both capital and labour gain unambiguously through trade. On the other hand the distributional consequences for the labour-rich country hinges crucially on the scale economies. Though labour stands to gain, the returns to capital might fall. This result has serious political economic implication. Labour in both the countries would prefer a liberalized trade regime, whereas capital owners in the labour-rich countries might favour a protectionist policy. This is in accord with the recent experiences of the LDCs, where initiatives have been taken to reorient the economy towards a more liberalized trade regime. Capitalists in these countries have been raising a furore over trade liberalization and seeking more protection on the ploy that they be offered a level playing ground before the economy opens up to foreign competition. It is further shown that the forces of comparative advantage perforce must have opposite effects on the expansion of the already under-produced intermediate goods. Intermediate goods are under-produced in the sense that price exceeds marginal cost for these goods. As has been shown by Markusen and Melvin (1981), trade under imperfect

competition is surely gainful if it leads to the expansion of the distorted (price exceeding marginal cost) sector. In the present model, the labour-rich country suffers a contraction of the distorted sector, thereby leading to a welfare loss. This can be nullified on balance only if the gains from specialization arising from intermediate goods trade are sufficiently high.

I develop the basic model and explore the autarky situation in Section I. Section II delineates the trade equilibrium, Section III discusses the distributional consequences and gains from trade, and Section IV concludes.

I. The Model

Consider an economy producing a final good Y, according to the production function

$$Y = X^{\alpha} L_y^{1-\alpha} \tag{1}$$

where

$$X = \left(\sum_{i=1}^{n} x_i^{\rho} \right)^{1/\rho} \quad \text{and } 0 < \alpha, \ \rho < 1;$$

x_i, $i = 1,\ldots,n$ are the intermediate inputs and L_y is the direct labour employed in the production of Y. Two features of X are important. The first is the imperfect substitutability of differentiated intermediate inputs. The elasticity of substitution (σ) between any pair of x_i is given by $1/(1-\rho)$, leading to a downward-sloping demand curve for single intermediate good producer. Higher values of ρ indicate less differentiation, easier substitution, more elastic demand and less market power for any single producer of intermediate input. The second feature to note is that X is increasing in n, the number of distinct intermediate inputs, keeping the total devoted resources constant. Thus, there are output gains to be made as resources are spread out more thinly over larger number of components. This incorporates the Smithian notion of increased division of labour, discussed by Ethier (1982) and Romer (1987). If all intermediate goods have identical cost functions leading to identical output (x), then with symmetry X collapses to

$$X = n^{1/\rho} x.$$

Thus in this formulation output of Y is characterized by constant returns to scale in the quantity of inputs, holding constant the number of varieties of intermediate inputs. However, the output of Y is increasing in the number of varieties, holding constant the aggregate quantity of inputs. As the number of inputs proliferates there is a gain to be made out of specialization over narrowly defined activities. One of Ethier's insights is that these activities need not be geographically concentrated. Trade in intermediate goods generates a form of international increasing returns.

The intermediate goods (x_i) are produced under increasing returns to scale. Because of fixed costs, no two firms will produce the exact same variety in equilibrium. With a large number of potential varieties, there is no strategic behaviour on the part of the firms. Finally, the absence of entry barriers drives

profits down to zero. Production of representative x_i requires a_k units of overhead capital, constituting the fixed cost,

$$a_k r = F, \tag{2}$$

where r is the rental rate and F is the fixed cost. The marginal cost component is

$$m = a_L w, \tag{3}$$

where a_L is the marginal labour requirement to produce each additional unit of x and w is the wage rate.

Assuming a large number of varieties such that strategic behaviour is ruled out on part of the firms producing intermediate goods, it can be shown that market elasticity of demand faced by producers of intermediates is equal to the elasticity of substitution (σ) between any two intermediate inputs, or $1/(1-\rho)$. Thus, each producer of intermediate inputs equates marginal revenue to marginal cost:

$$\begin{aligned} p_i\left(1-\frac{1}{\sigma}\right) &= a_L w \\ \Rightarrow p_i &= \frac{a_L w}{\rho}. \end{aligned} \tag{4}$$

The prices of intermediates are a constant mark-up over the marginal cost, and with identical technology all firms charge the same price for intermediate ($p_i = p$).

Free entry drives profits down to zero. Thus, the operating surplus must be just enough to cover the fixed cost.

$$\frac{p_i}{\sigma} x_i = a_k r. \tag{5}$$

This also implies that output x_i is the same for all producers ($x_i = x$).

The full-employment condition for labour and capital is given by

$$L_x + L_y = a_L n x + L_y = L \tag{6}$$

$$a_k n = K, \tag{7}$$

where L_x and L_y are the employment levels in the intermediate and final goods sector and L and K are the total labour and capital endowments of the country. Thus, the number of input varieties are given directly from the full-employment condition of capital.

The price index of the composite intermediate input bundle $X = \left(\Sigma_{i=1}^{n} x_i^{\rho}\right)^{1/\rho}$ is given by

$$P^{1-\sigma} = \sum_{i=1}^{n} p_i^{1-\sigma}. \tag{8}$$

The composite price index P may be interpreted as the unit cost function of X. Thus, the effective price P is positively related to the prices of each intermediate input p_i and negatively related to the number of available varieties of intermediate inputs (n). The later relation captures the gains from specialization.

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Producers of final good Y (numeraire) maximize profits by choosing the optimal input mix of labour and specialized intermediate inputs, taking the number of intermediate-goods-producing firms (n), the wage rate w and the prices of intermediate inputs p_i as given, subject to the production function (1). The first-order conditions for profit maximization are given by

$$(9) \qquad \frac{\partial Y}{\partial L_Y} = (1-\alpha)(X/L_Y)^{\alpha} = w,$$

$$(10) \qquad \frac{\partial Y}{\partial X} = \alpha(X/L_Y)^{\alpha-1} = P.$$

Dividing (9) by (10), we get

$$(11) \qquad \frac{(1-\alpha)}{\alpha}\frac{X}{L_Y} = \frac{w}{P}.$$

Under the condition that intermediate goods production are subject to identical cost conditions across board, prices and output of representative intermediate input are $p_i = p$ and $x_i = x$ respectively. Thus in this symmetric equilibrium equation (8) collapses to

$$(12a) \qquad P = n^{1/(1-\sigma)}p,$$

$$(12b) \qquad X = n^{1/\rho}x.$$

Using (12) in (11),

$$(13) \qquad \frac{(1-\alpha)}{\alpha}\frac{nx}{L_Y} = \frac{w}{p}.$$

Taking note of (4), (13) can be rewritten as

$$(14) \qquad \frac{nx}{L_Y} = \frac{\alpha}{(1-\alpha)}\frac{\rho}{\alpha_L}.$$

Using the full-employment condition for labour, equation (6), we rewrite (14) as

$$(15) \qquad \frac{L_X}{L_Y} = \frac{\alpha\rho}{(1-\alpha)}.$$

Hence the allocation of labour across sectors is fixed by the parameters of the final output production function.

Using (14) in (9), the unit cost function for final output Y can be calculated at given factor prices. For good Y to be produced, unit costs must equal price $pY = 1$. Thus,

$$(16) \qquad (1-\alpha)^{-1}\left(\frac{\alpha}{1-\alpha}\frac{\rho}{a_L}\right)^{-\alpha} n^{-\alpha/(\sigma-1)}w \geqslant 1$$

with equality if $Y > 0$.

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Equation (16) reveals that a higher number of intermediate goods *ceteris paribus* will translate into higher wage rates. This reflects the standard productivity gains arising from specialization.

Thus, with Y sector operative, the wage rate is given by

$$w = Mn^{\alpha/(\sigma-1)}, \tag{16a}$$

where

$$M = (1-\alpha)\left(\frac{a}{(1-\alpha)}\frac{\rho}{a_L}\right)^{\alpha}.$$

Using (4) prices of intermediate input is given by

$$p = \frac{a_L M n^{\alpha/(\sigma-1)}}{\rho}. \tag{17}$$

Equation (15), along with the full employment condition (6), gives the x-sector employment

$$L_x = L - L_y = \frac{\alpha\rho}{(1-\alpha+\alpha\rho)}L. \tag{18}$$

Using (18) and (6), output per variety of intermediate input is

$$x = \frac{\alpha\rho}{(1-\alpha+\alpha\rho)}\frac{L}{a_L n}. \tag{19}$$

Using (19) and (17) in (5) and taking note of (7),

$$r = \left(\frac{Mn^{\alpha/(\sigma-1)}}{\rho\sigma}\right)\left(\frac{\alpha\rho}{1-\alpha+\alpha\rho}\right)\frac{L}{K}. \tag{20}$$

Thus, the autarkic equilibrium is solved for all the eight endogenous variables, Y, x, p, w, r, L_x, L_y, n.

II. TRADE

There are two countries, home and foreign. In what follows I assume that both intermediates and final goods are tradable, and that home and foreign countries are identical in all respects except possibly their labour–capital endowment ratios. Where necessary, I denote the foreign values of variables by a superscript f and home values by h.

With the ability to import foreign varieties of intermediate inputs, the composite price index of intermediate goods bundle X^h is given by

$$(P^h)^{1-\sigma} = \left[\sum_{i=1}^{n^h}(p_i^h)^{1-\sigma} + \sum_{j=1}^{n^f}(p_j^f)^{1-\sigma}\right]. \tag{21}$$

where $X^h = [n^h(x_h^h)^\rho + n^f(x_h^f)^\rho]^{1/\rho}$, with x_j^i denoting the amount of intermediate input produced in the ith country and used by the jth country producers of Y.

This is also the relevant price index for the foreign country under the condition that trade is unimpeded by tariff, taxes or transport cost.

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Final output producers of Y maximize profits by choosing the optimal input mix taking the number of available varieties of intermediate inputs (foreign and home), the prices p_i^h and p_j^f and the wage rate w^h as given subject to the production function (1). The usual first-order conditions are

$$(22) \qquad \frac{\partial Y^h}{\partial L_y^h} = (1-\alpha)(X^h/L_y^h)^{\alpha} = w^h,$$

$$(23) \qquad \frac{\partial Y^h}{\partial X^h} = \alpha(X^h/L_y^h)^{\alpha-1} = P^h.$$

Dividing (22) by (3), we have

$$(24) \qquad \frac{X^h}{L_y^h} = \frac{\alpha}{(1-\alpha)}\frac{w^h}{P^h}.$$

Substituting (24) in (22), we get the unit cost function for Y. With Y sector in operation, unit cost function is equal to the price of Y. Thus,

$$(25) \qquad \frac{(P^h)^{\alpha}(w^h)^{1-\alpha}}{(1-\alpha)^{1-\alpha}\alpha^{\alpha}} = p_Y = 1$$

With free trade equalizing the price (p_Y) of final goods, and noting that with free trade in intermediate inputs the composite price indices are equalized[1] (i.e. $P^h = P^f$), equation (25) implies that wage rates are equalized across countries (i.e. $w^h = w^f$), under the condition that technologies are identical.

The demand–supply equilibrium of intermediate goods market is given by

$$(26a) \qquad x^h = x_h^h + x_f^h,$$

$$(26b) \qquad x^f = x_h^f + x_f^f,$$

where x^h and x^f are the supplies of a representative brand of intermediate input of home and foreign country respectively and the right-hand side denotes the aggregate demands.

The demand function for intermediate inputs are given by

$$(27) \qquad x_j^i = \frac{(p^i)^{-\sigma}P^jX^j}{(P^j)^{1-\sigma}}$$

(Helpman and Krugman 1985). Using (27) in (26),

$$(28a) \qquad x^h = \frac{(p^h)^{-\sigma}P^hX^h}{(P^h)^{1-\sigma}} + \frac{(p^h)^{-\sigma}P^fX^f}{(P^f)^{1-\sigma}}$$

$$(28b) \qquad x^f = \frac{(p^f)^{-\sigma}P^hX^h}{(P^h)^{1-\sigma}} + \frac{(p^f)^{-\sigma}P^fX^f}{(P^f)^{1-\sigma}}$$

Dividing (28a) by (28b),

$$(29) \qquad \frac{x^h}{x^f} = \left(\frac{p^h}{p^f}\right)^{-\sigma}.$$

However, as has already been shown, wage rates are equalized through free trade and, with prices of intermediate goods being a constant mark-up over the marginal wage cost, equation (4) implies that prices of intermediates in both countries are equalized, i.e. $p^h = p^f$. Therefore equation (29) implies that the outputs per brand of intermediate inputs in both countries are equal. Thus, with prices and output per brand equalized across countries, the operating surpluses for each intermediate goods producer are equal. Hence the rental rates are equalized by equation (5). The following proposition is immediate.

Proposition 1. Free trade in final goods and intermediate goods equalizes factor returns in both countries, under the condition that technologies are identical.

With the wage rates and hence prices of intermediates equalized across countries, the home-country wage rate can be now written, using (25), as

$$w = M(n^h + n^f)^{\alpha/(\sigma-1)}. \tag{30}$$

Comparing (30) with (16a), it is evident that free trade increases the wage rate in both the countries and that this increase is directly related to the larger number of available varieties of intermediate inputs. The productivity gains arising from specialization are translated into higher wage rates. Interestingly enough, wage rates in both countries increase irrespective of labour being the scarce or abundant factor.

Proposition 2. Free trade raises wage rates in both countries, irrespective of labour being the scarce or abundant factor.

Although I have shown that trade equalizes factor returns, I have not as yet determined the rental rates. This will be determined once I have determined the labour allocation across sectors. Demand–supply equilibrium in final output market is given by

$$Y_S^w = Y_D^w, \tag{31}$$

where Y_S^w and Y_D^w are world supply and demand for good Y.

Noting that equalization of wages, and hence prices of intermediates between countries, imply that equation (24) can be written as

$$\frac{X^h}{L_y^h} = \frac{\alpha}{1-\alpha}\frac{\rho}{\alpha_L(n^h + n_f)^{1/(1-\sigma)}}. \tag{32}$$

Substituting (32) in the production function (1), the home country supply function for good Y, we have

$$Y_s^h = \left(\frac{\alpha}{(1-\alpha)}\frac{\rho}{\alpha_L}\right)^{\alpha}(n^h + n^f)^{\alpha/(\sigma-1)}L_y^h. \tag{33}$$

Similarly,

$$Y_s^f = \left(\frac{\alpha}{(1-\alpha)}\frac{\rho}{\alpha_L}\right)^{\alpha}(n^h + n^f)^{\alpha/(\sigma-1)}L_y^f. \tag{34}$$

As there is only one final good Y, the home demand for Y is given by the total factor earnings. Using (4)–(7),

$$(35)\qquad Y_D^h = wL^h + rK^h = wL^h + \frac{a_L w}{\rho\sigma a_k}\frac{(L^h - L_y^h)}{a_L n^h}K^h$$
$$= w\left(L^h + \frac{1}{\rho\sigma}\frac{(L^h - L_y^h)}{K^h}K^h\right).$$

The foreign counterpart can be written as

$$(36)\qquad Y_D^f = w\left(L^f + \frac{1}{\rho\sigma}\frac{(L^f - L_y^f)}{K^f}K^f\right).$$

Now, using the Y market equilibrium condition (31) and invoking the respective supply demand functions (33)–(36), we get

$$(31a)\qquad \left(\frac{\alpha}{(1-\alpha)}\frac{\rho}{a_L}\right)^{\alpha}(n^h + n^f)^{\alpha/(\sigma-1)}(L_y^h + L_y^f)$$
$$= w\left(L^h + L^f + \frac{(L^f - L_y^f)}{\rho\sigma K^f}(K^h + K^f)\right),$$

where use has been made of the fact that factor rewards are equalized between countries. With n^h and n^f determined directly from the full-employment condition for capital, (31a) contains two variables, L_y^h and L_y^f, to be solved for. We have already shown that the outputs of each intermediate good in both countries are equal—note equation (29). This implies that

$$(37)\qquad \frac{L_x^h}{a_L n^h} = \frac{L_x^f}{a_L n^f}$$

$$\Rightarrow \frac{(L^h - L_y^h)}{a_L n^h} = \frac{(L^f - L_y^f)}{a_L n^f}.$$

Thus, using the relation of L_y^h and L_y^f given in (37), (31a) can be transformed into an equation in one variable L_y^f,

$$(38)\qquad L_y^f = \frac{L^f[(1-\alpha)\rho\sigma n^f + \rho\sigma n^h + (1-\alpha)(n^h + n^f)] - \rho\sigma\alpha n^f L^h}{(1-\alpha+\rho\sigma)(n^h + n^f)}.$$

Having, determined L_y^f, we can determine L_y^h. With the sectoral allocation of labour at hand, the scale of intermediate goods production $x^h = x^f = x$ is determined, and then r:

$$(39)\qquad x^h = x^f = x = \frac{\alpha\rho}{(1-\alpha+\alpha\rho)}\frac{(L^h + L^f)}{(n^h + n^f)a_L},$$

$$(40)\qquad r = \frac{px}{\sigma a_k} = \frac{M(n^h + n^f)^{\alpha/(\sigma-1)}}{\rho\sigma}\frac{(\alpha\rho)}{(1-\alpha+\alpha\rho)}\frac{(L^h + L^f)}{(K^h + K^f)}.$$

With all the endogenous variables relevant to trade equilibrium determined, the trade pattern becomes obvious. To explore the pattern formally, let us note that at equilibrium L_y^f, the foreign country is an exporter of the final good Y if

$$Y_s^f > Y_D^f. \tag{41}$$

Substituting (34) and (36), (41) implies

$$L_y^f > (1-\alpha)\left(L^f + \frac{(L^f - L_y^f)}{\rho\sigma}\right). \tag{42}$$

Substituting the equilibrium value of L_y^f from (38), (42) is reduced to

$$\frac{L^f}{K^f} > \frac{L^h}{K^h}. \tag{43}$$

The following proposition is immediate.

Proposition 3. The country with the higher labour–capital ratio is the exporter of the final good and thereby a net importer of the intermediate goods.

Thus, endowment differences between countries determine the extent of the trade across stages of production. Put differently, it is the force of comparative advantage that is crucial in determining this trade between stages.

III. Gains from Trade and the Distributional Conflict Thereof

We have already seen that the wage rates are higher in both countries under trade, whether or not labour is a scarce or abundant factor. Thus, irrespective of the forces of comparative advantage, the gains from specialization attendant to trade raise the wage rates in both the countries. On comparing equations (39) and (19), it is evident that for the capital-rich country output of a representative brand of intermediate input x increases with the opening up of trade. This follows from the fact that $(L^h+L^f)/(K^h+K^f) > L^h/K^h$ (on the assumption that home country is capital-rich). This increase in output x *ceteris paribus* leads to a larger operating surplus and hence to higher rental rates. This is further augmented over by a rise in the price of intermediate inputs, coming through the productivity gains arising from specialization, as the available array of intermediates increases. Thus, the rental rates are unambiguously higher in the capital-rich country.

This is not true for the labour-rich country, where trade leads to a contraction of intermediate goods output x in accordance with the forces of comparative advantage, thus leading to a lower operating surplus and hence to lower rental rates. This loss can be offset only if the prices of intermediates move up sufficiently. This will be true only if the returns from specialization are sufficiently high and the available array of intermediate goods is sufficiently larger than under autarky.

Equations (20) and (40) can be written as

$$r_a^f = M(n^f)^{\frac{(1+\alpha-\sigma)}{(\sigma-1)}} \frac{\alpha}{(1-\alpha+\alpha\rho)\sigma a_k} L^f, \tag{44}$$

$$r_t^f = M(n^h + n^f)^{\frac{(1-\alpha-\sigma)}{(\sigma-1)}} \frac{\alpha}{(1-\alpha+\alpha\rho)\sigma a_k} (L^h + L^f), \tag{45}$$

where r_a^f and r_t^f are the rental rates in the foreign country (assumed to be labour-rich) under autarky and trade, respectively.

Comparing (44) and (45), one sufficient condition for the rental rate in the labour-rich country to be higher under trade than under autarky is given by

$$\sigma < (1+\alpha). \tag{46}$$

Proposition 4. The capital-rich country is immune to distributional conflicts following trade, in the sense that both wage and rental rates are higher than in autarky, whereas for the labour-rich country the wage rate is unambiguously higher than in autarky but rental rates might be lower. One sufficient condition under which such distributional conflict is ruled out is given by $\sigma < (1+\alpha)$. Furthermore, if the countries are perfectly symmetric with the same labour–capital ratio, trade across stages of production freezes and distributional conflicts are ruled out.

This is in sharp contrast to the results derived in Krugman (1981), where both the countries are symmetrically exposed to the distributional conflict attendant to trade. The structure of our model is inherently such as to make countries with differing labour–capital ratios respond differently to the forces of comparative advantage. For the labour-rich country, trade shifts labour out of the intermediate goods sector into the final goods sector, thereby leading to a contraction of the output per variety of intermediate goods. The loss of operating surplus on this count can be compensated only if the prices of intermediates shoot up sufficiently. This will be the case only if the new array of intermediate inputs is sufficiently large and/or if the returns to specialization are adequately high, as reflected in low $\sigma(\sigma < (1+\alpha))$. For the capital-rich country, on the other hand, the rental rate increases on both counts, the scale of intermediate output goes up as labour shifts out of the Y sector into the intermediate goods sector, and the prices of intermediates are also higher.

The distributional consequence of trade suggested by this model might seem to be in conflict with the empirical results suggested by the recent trade–wages debate. This needs some clarification. To the extent that one interprets capital (K) and labour (L) in our model as skilled and unskilled labour, respectively, this would entail that the wage rate of unskilled labour in both the countries increases following the opening up to trade. This is apparently in contradiction of the recent phenomenon of rising income inequality in the developed countries reported in the works of Wood (1994, 1995) and Jones and Engerman (1996). Naturally, one can identify developed countries with the

capital-rich country in our model. This would mean that both skilled and unskilled wage increases in the developed country. This apparent paradox in our model is resolved when one looks at the relative wage rates (w/r), where w and r are now interpreted as unskilled and skilled wage rates, respectively. Noting equations (4) and (5), $w/r = z/x$, where $z = \rho\sigma a_k/a_L$ (a constant).

This means that the relative wage rate is exclusively dependent upon the per-firm output (x) of intermediate goods. Now I have already shown that for the capital-rich country (here to be read as 'developed country') x increases following opening up to trade. This implies that w/r falls. Alternatively, one can say, for such a country, that the skilled wage rate increases relative to the unskilled wage, and that this is perfectly in consonance with the recent experience for the developed country, where the skilled–unskilled wage gap has increased.

On the other hand, the model suggests that w/r would rise for the labour-rich country (which can be identified as the developing country). Empirical reports on the skilled–unskilled wage gap in developing countries have been relatively scarce, and whatever few have been reported are mixed in their conclusions. Wood (1997) asserts that for the East Asian nations export growth did close the wage gap between skilled and unskilled workers, but he also provides evidence that the skilled–unskilled wage gap has widened since some of the Latin American nations went in for a liberalized trade and investment regime.

Not dragging the inference of this model too far, one might say that the results in the model come closer to the East Asian experience. I have already argued that the present model was geared to account for the trade pattern followed by the East Asian nations (NICs) and the developed countries where large part of trade is in assembled commodities (assembled in the NICs). The distributional consequence of such trade, which can be deduced here also, fares well against the empirical results.

In fact, as is evident, the relative factor rewards w/r in our model follow the same direction as would be suggested by the Stolper–Samuelson theorem. To that extent, our model can provide only as much explanation for relative factor rewards as the standard Heckscher–Ohlin model.[2]

There being only one final good Y, the economy-wide consumption of the final good can reasonably be taken as an index of welfare. Thus, our earlier discussion carries over to the context of the gains from trade. The capital-rich country unambiguously gains as both wage and rental rates are higher, but this might not be the case for the labour-rich country. Assuming the foreign country to be labour-rich,

$$(47) \qquad Y^f_{Da} = w^f_a L^f + r^f_a K^f = M(n^f)^{\alpha/(\sigma-1)}\left(L^f + \frac{\alpha\rho}{(1-\alpha+\alpha\rho)\rho\sigma}\frac{L^f}{K^f}K^f\right),$$

$$(48) \qquad Y^f_{Dt} = w^f_t L^f + r^f_t K^f = M(n^f + n^h)^{\alpha/(\sigma-1)}\left(L^f + \frac{\alpha\rho}{(1-\alpha+\alpha\rho)\rho\sigma}\frac{L^f + L^h}{K^f + K^h}K^f\right),$$

where subscripts a and t imply autarky and trade regimes. Trade will lead to gains for the foreign (labour-rich) country if

$$(49) \qquad Y^f_{Dt} > Y^f_{Da} \Rightarrow \left(\frac{n^h + n^f}{n^f}\right)^{\alpha/(\sigma-1)} > \frac{1+c}{1+c\frac{L^h+L^f}{K^h+K^f}\frac{K^f}{L^f}},$$

where $c = \alpha\rho/[(1-\alpha+\alpha\rho)\rho\sigma]$.

Proposition 5. The capital-rich country unambiguously gains from trade, whereas the labour-rich country gains only if equation (49) is valid.

This result is closely akin to Markusen and Melvin (1981). They show that under imperfect competition one sufficient condition for trade to be gainful is that the distorted sector in which price exceeds marginal costs experiences an expansion. This is what is referred to as the 'product expansion condition' in the literature. In the present model the capital-rich country experiences an expansion of the distorted sector (x-sector, in which prices are a constant mark-up over the marginal cost, and gains unambiguously, whereas for the labour-rich country the intermediate goods output contracts, violating the 'product expansion condition'. In this model the forces of comparative advantage perforce leads to a contraction of the already under-produced good (under-produced in the sense that prices are higher than the marginal cost), leading to a welfare loss that can be only outweighed if the international increasing returns captured though trade in intermediate inputs are sufficiently high.

IV. SUMMARY

I have constructed a model incorporating the features of increasing returns, cast in a monopolistically competitive framework, with one final good and an intermediate goods sector. I have showed how the force of comparative advantage serves as the crucial determinant of trade between stages of production. I also showed that the forces of comparative advantage are such as to lead to an expansion of the distorted sector (price exceeding marginal cost) in the capital-rich country and to a contraction of the same sector in the labour-rich country. Thus, the usual pro-competitive effects of trade are stalled in the labour-rich country. Finally, I showed, that countries differing in labour–capital ratios are asymmetrically exposed to the distributional conflicts attendant to trade. The capital-rich country is shown to be immune to any distributional conflict, whereas the labour rich country is not necessarily so immune.

ACKNOWLEDGMENTS

This paper is based on a chapter of my PhD, thesis submitted to the Indian Statistical Institute, Calcutta. I wish to thank my thesis supervisor, Professor Abhirup Sarkar, for valuable comments and suggestions. I also wish to thank two anonymous referees for their constructive criticisms.

NOTES

1. This is readily confirmed by noting the expression for composite price index equation (21). With free trade in intermediate goods, final goods producers in the both countries will have access to the same number of intermediate varieties (n^h+n^f) and will pay the same price p^h and p^f for intermediate goods of h and f country origin, respectively.
2. Possibly a more accurate explanation of changing wage gaps have to take into account of the effects of technology, the role of foreign investment, etc., none of which have been addressed in the present model. Berman *et al.* (1994) claim that widening wage gap is due to technological progress which has been biased in favour of skilled labour. Feenstra and Hanson (1995) argue that 'outsourcing' through increasing foreign investment in developing countries has widened the wage gap between skilled and unskilled; foreign investment, according to their specification, boosts up production of skill-intensive products, thus increasing skilled wage rates. Admittedly, the present model abstracts from these richer interactions of trade, technology, investments, etc.

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