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Trade Liberalisation and the Distribution of Welfare Gains under Imperfect Competition

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ABSTRACT. – This paper examines the effects on factor prices and welfare of partial trade liberalisation. The model is general equilibrium with two countries, two factors, and three sectors – perfectly competitive, imperfectly competitive and trading resources. As trade is liberalised changes in factor prices and thus welfare may be non-monotonic even if the countries are identical. Differences across countries introduce Stolper-Samuelson considerations and affect the relative incentives for trade liberalisation across countries and factors.

La libéralisation du commerce international et la répartition du bien-être en concurrence imparfaite

RÉSUMÉ. – Cet article analyse l'impact de la libéralisation partielle du commerce sur le prix des entrants et le bien-être, dans un modèle d'équilibre général – à deux pays, deux inputs, trois secteurs – parfaitement concurrentiel, imparfaitement concurrentiel, réalisant les moyens d'échange. Même si les pays sont identiques, cette libéralisation peut produire des changements non monotones. Les différences entre pays introduisent des effets Stolper-Samuelson, et influencent l'incitation relative à libéraliser, pour chaque pays, et pour chaque facteur.

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1 Introduction

The literature on the welfare implications of trade liberalisation under either perfect or imperfect competition is well established. Central to the traditional, perfectly competitive analyses are general equilibrium considerations where the gains from trade arise from an improved allocation of resources according to comparative advantage. In contrast, models of trade under imperfect competition are largely either single sector models or partial equilibrium. Welfare gains usually arise from increases in the degree of competition (BRANDER [1981]; MARKUSEN [1981]; BRANDER and KRUGMAN [1983]; VENABLES [1987]), increases in the number of varieties (KRUGMAN [1980]), or from scale economies (KRUGMAN [1979], VENABLES [1985]). The precise source of the gains will in turn depend on the underlying assumptions – the extent to which products are homogeneous or differentiated, the endogeneity of firm numbers, the nature of competitive interaction, or the degree of market segmentation.

Imperfectly competitive models can be neatly embedded within the traditional two-sector general equilibrium approach (DIXIT and NORMAN [1980]; KRUGMAN [1981]; HELPMAN [1981]; LAWRENCE and SPILLER [1983]; HELPMAN and KRUGMAN [1985]). The gains from trade can then be understood with reference to the welfare properties of the respective approaches. Lawrence and Spiller show an *overall* welfare gain in moving from autarky to free trade and the greater the disparity in initial factor endowments the larger the gain. As in the traditional model this arises primarily from improvements in resource allocation. Focusing on the distribution of the gains, KRUGMAN [1981] shows that it is more likely that both *factors* will gain from trade the more differentiated are products and the greater the similarity in factor endowments. This reinforces the partial equilibrium conclusions, for if there were no differences in factor endowments there would be no Heckscher-Ohlin (net) trade. Hence neither factor could lose from adverse changes in factor prices, but there are gains from increased consumption of differentiated products; and the more consumers value differentiation the greater will be that gain.

This paper examines these propositions. However, whereas the conclusions outlined above are based on a comparison of free trade with autarky outcomes, this paper assesses the paths of factor prices and welfare as trade is liberalised. In both the traditional and the imperfectly competitive literature there is comparatively little analysis of the presence of trade/transport costs and the effects of their reduction [1]. This is perhaps surprising given that

1. Within the Heckscher-Ohlin framework where transport costs have been included this has been primarily in the context of the transfer problem (e.g. SAMUELSON [1952, 1954], FALVEY [1976]), or to examine the implications for the traditional corollaries of a given level of trade costs (eg. CASSING [1978]). Within the imperfectly competitive trade literature the importance of trade costs and their reduction has been highlighted when looking at differences in market size and hence market access (e.g. KRUGMAN and VENABLES [1990], GASIOREK [1994]).

virtually all trade takes place in the presence of trade costs, be they, for example, transport costs or non-tariff barriers to trade. While it may be natural to suppose that trade liberalisation entails monotonic changes in, for example factor prices and welfare, as shown in this paper, this is unlikely to be the case. Even if there are welfare gains in moving from autarky to free trade, a partial liberalisation of trade may have different welfare implications and the nature of the changes depends on the factor intensity of the trading resources sector. The inclusion of trade costs is therefore an important step in trying to improve the realism of the theoretical literature. The structure of the paper is as follows. Section 2 outlines the theoretical model. Section 3 analyses the consequences for factor prices and sectoral output of the reduction of trade barriers for two identical countries. In section 4 the implications of the preceding section for the distribution of welfare changes is examined. The fourth section allows for differences in factor endowments, assesses the implications for the previous results, and explores the consequences for overall welfare changes. Finally, Section 6 offers some conclusions.

2 Description of The Model

The model is a general equilibrium model consisting of a perfectly competitive sector, an imperfectly competitive sector producing under conditions of increasing returns to scale, and a sector producing the resources employed in trading. This sector is referred to as the trading resources sector. Rather than modelling this sector explicitly, different characterisations of this sector are derived from the way in which trade costs in the imperfectly competitive sector are modelled. The perfectly competitive sector produces a traded homogeneous product, and the imperfectly competitive sector produces differentiated products, x_{ij}, with prices p_{ij}, where the subscripts i and j denote the prodcution and consumption location respectively.

The modelling of demand follows DIXIT and STIGLITZ [1977]. There is a single representative consumer in each country, and utility is maximised according to a two-stage budgeting procedure. In the first stage consumption is allocated between the perfectly competitive sector and the imperfectly competitive sector, and in the second stage across different varieties of the imperfectly competitive sector. The top level utility function in country i,

$$U_i = Z_i^{1-s} Y_i^s, \qquad 0 < s < 1 \tag{1}$$

is maximised subject to the overall budget constraint,

$$I_i = Y_i Q_i + Z_i^d \tag{2}$$

where Y_i and Q_i are the quantity index and price index for differentiated products. Z_i^d is the quantity of the perfectly competitive sector good demanded (the perfectly competitive sector is taken to be the numeraire with

its price normalised at (1). This yields the following Marshallian demand functions:

$$\begin{cases} Z_i^d = I_i\,(1-s) \\ Y_i^d = I_i\,s/Q_i \end{cases} \tag{3}$$

The quantity and price indices, Y_i and Q_i are assumed to be CES aggregators, where,

$$Y_i = [\sum_i n_i\,x_{ij}^{\alpha}]^{1/\alpha} \tag{4}$$

$$Q_i = [\sum_j n_i\,p_{ij}^{\frac{\alpha}{\alpha-1}}]^{\frac{\alpha-1}{\alpha}} \tag{5}$$

The quantity index can be interpreted as a sub-utility function over differentiated products with elasticity of substitution, $1/(1-\alpha)$. Demand for individual varieties of differentiated products is derived by differentiation of the expenditure function over imperfectly competitive sector products, $E_i = Y_i\,Q_i$, with respect to individual prices, p_{ij}.

$$x_{ij} = I_j\,s\,Q_j^{\frac{\alpha}{1-\alpha}}\,p_{ij}^{\frac{1}{\alpha-1}} \tag{6}$$

With the Chamberlinian large group assumption the elasticity of demand for an individual product variety is given by the elasticity of substitution, $1/(1-\alpha)$.

Production in the perfectly competitive sector is given by a Cobb-Douglas function,

$$Z_i = K_{zi}^{\varepsilon}\,L_{zi}^{(1-\varepsilon)} \tag{7}$$

where K_{zi} and L_{zi} are the amounts of capital and labour used in the perfectly competitive sector in country j, and the exponents represent the share of capital and labour in production. Dual to the production function is the unit cost function, $b_i\,(w_i,\,r_i)$, where r_i and w_i represent the return to capital and labour respectively. Setting marginal revenue equal to marginal cost ensures, that,

$$b_i\,(w_i,\,r_i) = 1 = w_i^{(1-\varepsilon)}\,r_i^{\varepsilon}\,\phi, \qquad \text{where} \quad \phi = \varepsilon^{-\varepsilon}\,(1-\varepsilon)^{(\varepsilon-1)} \tag{8}$$

Equation 8 implies that $r_i = r_i\,(w_i)$. Increasing returns in the imperfectly competitive sector are given by assuming a cost function with a fixed cost (f) a constant component of marginal cost (c), and factor prices,

$$TC_i = A_i\,[f + c\sum_j x_{ij}] \tag{9}$$

where:

$$A_i = r_i^{\eta}\,w_i^{(1-\eta)}\,\varphi, \quad \varphi = \eta^{-\eta}\,(1-\eta)^{(\eta-1)}, \quad 0 < c < 1$$

and total firm output is given by $\sum_j x_{ij}$. Profits for each firm in country i are given by,

$$\pi_i = \sum_j p_{ij}\,(1 - t_{ij})\,x_{ij} - TC_i \tag{10}$$

Where the t_{ij}'s represent the costs of exporting from country i to country j. With segmented markets and the large group assumption, profit maximisation implies,

$$p_{ij} = A_i\,c/(1 - t_{ij})\,\alpha, \qquad \text{where } t = 0 \text{ when } i = j \tag{11}$$

With free entry ($\pi_i = 0$) equations 9, 10 and 11 can be used to solve for output per firm,

$$\sum_j x_{ij} = f\,\alpha/c(1 - \alpha) \tag{12}$$

Where the trade barriers represent real costs of trading then the production of these real resources needs to be included. Characterisation of the resources used up in trading is achieved through the specification of commodity market clearing. If commodity market clearing is assumed in the perfectly competitive sector then by applying Walras' Law the resources used up in trading must be produced by the other explicitly specified sector – the imperfectly competitive sector. This is what is often referred to in the literature as "iceberg" trade costs, and is described as a certain proportion of the good being lost, or melting, in transit. Alternatively, if commodity market clearing were specified in the imperfectly competitive sector then the resources employed in trading would be produced by the perfectly competitive sector [2]. For the remainder of the paper these alternative specifications will be referred to as iceberg and ad valorem trade costs respectively [3].

Factor demands are derived by Shephard's Lemma, by partial differentiation of the cost functions with respect to factor prices. With factor supplies given, factor market clearing is then given by:

$$L_i = \frac{Z_i\,(1 - \varepsilon)}{w_i} + \frac{n_i\,(1 - \eta)\,A}{w_i}\,[f + c\sum_j x_{ij}] \tag{13a}$$

$$K_i = \frac{Z_i\,\varepsilon}{r_i\,(w_i)} + \frac{n_i\,\eta\,A_i}{r_i\,(w_i)}\,[f + c\sum_j x_{ij}] \tag{13b}$$

2. An equivalent way of achieving this characterisation of the production of the resources used up in trading is to include the demand for those resources in the specification of commodity market clearing. Hence, if equation 6 were replaced with $x_{ij} = I_j\,\mu\,Q_j^{\frac{\alpha}{1-\alpha}}\,p_{ij}^{\frac{1}{\alpha-1}}\,(1 - t_{ij})^{-1}$, this then includes the demand for the trading resources.

3. Iceberg trade costs are, of course, also ad valorem. The usage here of the terms iceberg and ad valorem is for ease of exposition and follows the implicit common practice in the literature.

The model can be closed by specifying the overall budget constraint

$$w_i L_i + r_i K_i + TR_i = I_i = Y_i Q_i + Z_i^d \tag{14}$$

TR is tariff revenue and is zero if the trade barriers represent real costs of trading; the value of the resources used up in trading is then included in either of the other sectors. For analytical convenience throughout the paper it is assumed that there are only two economies and that the imperfectly competitive sector is labour intensive.

3 Trade Liberalisation and Factor Prices

In this section it is assumed the economies have *identical* factor endowments. Trade will then be pure intra-industry and neither country will export the perfectly competitive sector good. As in the traditional $2\times2\times2$ Heckscher-Ohlin model, with fixed factor endowments and different intensities in the sectors of production ($\varepsilon \neq \eta$) changes in factor prices depend on and reflect changes in the sectoral composition of output. In the trading resources sector output must initially rise as trade is liberalised and subsequently decline to zero at free trade. For the perfectly and imperfectly competitive sectors any changes in sectoral output will depend on changes in demand as trade costs are reduced.

3.1. Iceberg Trade Costs

The output changes in each of the sectors can be understood by examining the path of factor prices. The equations of the model can be used to solve for either factor price in terms of the parameters of the model (see Appendix) and with two sectors, and two factors of production the results can be discussed in terms of either factor price. Solving for wages yields:

$$w^I = \left[\frac{K}{L}\right]^{\varepsilon} \left[\frac{1-B}{B}\right]^{\varepsilon} \phi^{-1}, \qquad B = \varepsilon + s\,(\eta - \varepsilon) \tag{15}$$

where the assumption of identical factor endowments means the subscripts can be dropped and the superscript, I, refers to the underlying assumption of iceberg trade costs. Hence wages depend on the capital-labour ratio, factor intensities and on the share of each sector in consumption. If factor intensities are the same ($\varepsilon = \eta$) then the level of wages will depend on how labour intensitve the two sectors are. If factor intensities differ, for example where the imperfectly competitive sector uses no capital ($\eta = 0$), but where the share of expenditure falls equally on both sectors ($s = 0.5$), then as the perfectly competitive sector becomes more labour intensive (as ε declines)

then again wages rise. Finally, as the share of the imperfectly competitive sector in consumption rises (as s get bigger), then again wages rise.

Crucially, it can be seen that wages are invariant with respect to trade costs which in turn implies that total output using the technology of the imperfectly competitive sector, and total output in the perfectly competitive sector remain constant. The reduction in trade costs increases demand for imported differentiated products, where the price of imported goods will always be higher with positive trade costs. With the utility function given by (1) the share of consumer expenditure on each sector is constant. To maintain this share demand for the imperfectly competitive sector in each country must initially fall which would imply the contraction of the imperfectly competitive sector. At free trade the price of domestically produced and imported varieties is identical hence free trade levels of consumption are identical to autarky levels, though now consumption is divided equally between domestic and foreign varieties. This implies that at sufficiently low levels of trade costs, the level of consumer demand for the imperfectly competitive sector will rise. However, with the move away from autarky, trade in the imperfectly competitive sector requires the use of real resources. With iceberg trade costs output of the trading resources sector is produced using the technology of the imperfectly competitive sector. The special nature of iceberg trade costs means that the quantity of resources used up in the act of trading is exactly the same as the reduction arising from the changes in consumer demand. As trade costs are reduced output of the trading resources sector must initially rise and then fall to zero at free trade, and this mirrors the changes in consumer demand. Consequently total ouput in both the imperfectly competitive and perfectly competitive sectors, factor prices and national income remain unchanged. Note, however, that quantities exported and imported of the imperfectly competitive sector good are increasing as trade costs decline, which has implications for welfare.

3.2. **Ad Valorem Trade Costs**

The production technology in the trading resources and perfectly competitive sectors is now the same. Following the same procedure as above and solving for wages gives:

$$w^{AV} = \left[\frac{K}{L}\right]^{\varepsilon} \left[\frac{1 - B^{AV}}{B^{AV}}\right]^{\varepsilon} \phi^{-1}, \qquad B^{AV} = \varepsilon + \mathrm{T}s\,(\eta - \varepsilon) \tag{16}$$

where,

$$\mathrm{T} = 1 - \frac{t}{1 + (1-t)^{\alpha/(\alpha-1)}}$$

As before wages depend on the capital-labour ratio, factor intensities, the share of the imperfectly competitive sector in consumption, but now also on T; where T depends on trade costs, t, and the degree of product differentiation, α. At free trade and at autarky, $T = 1$, and thus factor prices, goods prices, numbers of firms and total industry output will be the same. As with iceberg trade costs autarkic consumption levels in the imperfectly competitive sector are given by domestic production; and under

free trade by production in both economies, when twice as many varieties but half as much of each will be consumed. The extend to which T influences wages for any given level of trade costs will depend on the degree of product differentiation. Thus as α approaches 1 the elasticity of demand for differentiated products becomes infinite (products become homogeneous), T approaches 1, and wages again become invariant with respect to trade costs.

However, providing products are differentiated then, taking the derivative of wages with respect to t gives:

$$\frac{\partial w^{AV}}{\partial t} = -\varepsilon \left[\frac{K}{L}\right]^{\varepsilon} \left[\frac{1 - B^{AV}}{B^{AV}}\right]^{\varepsilon - 1} \frac{s\,(\eta - \varepsilon)\,\partial \mathrm{T}/\partial t}{(B^{AV})^2}\,\phi^{-1} \tag{17}$$

The first two terms on the righ-hand side together with the denominator in the last term are positive for all values of trade costs, t. The change in wages as trade costs decline will then depend on the factor intensity of the sectors of production (η and ε) and on the sign of $\partial T/\partial t$, where:

$$\frac{\partial \mathrm{T}}{\partial t} = \frac{t\,\frac{\alpha}{1-\alpha}\,(1-t)^{1/(\alpha-1)} - [1 + (1-t)^{\alpha/(\alpha-1)}]}{[1 + (1-t)^{\alpha/(\alpha-1)}]^2} \tag{18}$$

Inspection of (18) reveals that its sign depends on the numerator, where both terms of the numerator are positive for all values of α and t between zero and one. For all values of α less than one there is a value of t such that the first term will be smaller than the second term. The size of this will depend on the value of alpha. As alpha approaches one, the value of t that satisfies this condition approaches zero. For lower values of alpha the sign of the derivative, and therefore the sign of the change in wages, will be non-monotonic and will depend on the precise level of trade costs. As trade barriers are reduced from autarkic levels the price of the factor used intensively in the production of the imperfectly competitive sector will decline and the price of the other factor will rise. At sufficiently low levels of trade barriers any further reduction will cause the price of the factor used intensively in the production of the imperfectly competitive sector to rise and the price of the other factor to fall.

As in the previous case, the reduction in trade costs results in an increase in demand for imported differentiated products. In order to maintain the constant expenditure share on each sector the total quantity of differentiated products demanded in each country falls. However, the trading resources sector now uses the same technology as the perfectly competitive sector. The reduction in demand in the (labour intensive) imperfectly competitive sector thus results in its contraction, which releases capital and labour and results in a fall in wages. As trade costs approach zero the price of domestically produced and imported goods will convergence, and the imperfectly competitive sector will then expand which serves to bid up the price of wages. Conversely production using perfectly competitive sector technology (perfectly competitive plus trading resources) will initially expand and subsequently contract.

The extent of this non-monotonicity will depend in the first instance on the difference in relative factor intensities (η and ε). The larger is the

difference in factor intensities the greater will be the changes in factor prices. Secondly, the non-monotonicity will depend on the elasticity of demand for differentiated products. The more inelastic is the demand the greater will be the increase in demand for (imported) differentiated products and the greater will be the contraction in output in this sector necessary to maintain the constant expenditure share. Finally, the larger is the share of the imperfectly competitive sector in consumption, s, the greater will be demand for differentiated products as trade costs are reduced and again the larger will be the changes in factor prices.

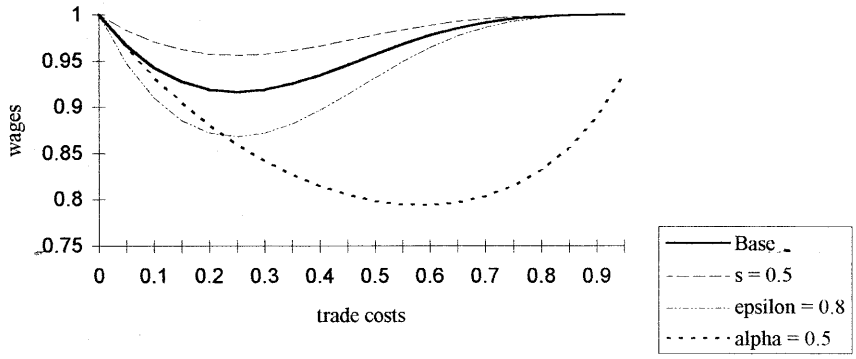

FIGURE 1

Path of Wages as Trade is Liberalised

These results can be seen in the simulations in figure 1 which shows the path of wages, as a proportion of wages at autarky, for different values of α, ε, η and s as trade costs are reduced, where free trade occurs when trade costs are equal to zero. In the base simulation parameter values were set such that $\varepsilon = 0.55$, $\eta = 0$, $\alpha = 0.8$; $s = 0.7$. For the other simulations each of the parameters was then set to a different value as shown. Unless otherwise indicated in all subsequent simulations the parameters take the base values.

3.3. **Tariffs**

If the trade barriers are assumed to be tariffs as opposed to trade costs (which use up real resources) then the analysis is similar to that with ad valorem trade costs, but there is now an income effect arising from the tariff revenue. Solving for wages yields:

(19)
$$w^{Ta} = \left[\frac{K}{L}\right]^{\varepsilon}\left[\frac{1+s\,(\mathrm{T}-1)-B^{Ta}}{B^{Ta}}\right]^{\varepsilon}\phi^{-1}, \quad B^{Ta} = \varepsilon\,(1-s)+\mathrm{T}s\,\eta$$

Comparing equations (16) and (19) reveals that factor prices will follow the same path as with ad valorem trade costs but the changes will be less

pronounced. Hence with the imperfectly competitive sector being labour intensive wages will always be higher with tariffs, $w^{Ta} > w^{AV}$. The absence of the trading resource sector has reduced the quantity of production using perfectly competitive sector technology, and therefore expanded relatively production of the imperfectly competitive sector. Consequently, under tariffs demand for differentiated products will always be greater than with ad valorem trade costs, and hence the price of the factor used intensively in that sector will be higher. Conversely the price of the other factor will be lower, and by extension the number of firms will always be greater with tariffs than with ad valorem trade costs.

The analysis above shows that even with identical endowments there may be distributional implications arising from trade liberalisation. In the traditional factor endowments approach where there is only inter-industry trade, the real return to the factor used intensively in the production of the export good rises, and the real return to the other factor falls (Stolper-Samuelson). These changes in factor prices arise because of changes in sectoral output which are driven by the relative differences in factor endowment ratios. In the model presented here such considerations have been assumed away. The return to the factor used intensively in the export sector initially falls, and the return to the other factor rises which is the reverse of the traditional outcome. These factor prices changes arise from changes in sectoral output which are driven both by the changes in demand for differentiated products, and by the changes in demand for the output of the trading resources sector. Even though the price of exported differentiated products is falling as is the price index of the imperfectly competitive sector, the price of the factor used intensively in the production of that good changes non-monotonically.

4 Trade Liberalisation and Welfare

As free entry in the model ensures zero profits, the welfare implications of trade liberalisation can be seen by focussing on changes in consumers' utility. The distribution of the welfare changes can be analysed by assuming that all consumers have the same utility function as given by (1), and by dividing income between owners of capital and labour. The indirect utility function is given by:

$$V = IQ^{-s}\left(1-s\right)^{(1-s)}s^{s} \tag{20}$$

Substituting with (5), (8) and (11) yields the indirect utility function for owners of labour:

$$V^{1} = w^{B/\varepsilon}\,L\,n^{\frac{s\,(1-\alpha)}{\alpha}}\,\hat{\mathrm{T}}D, \tag{21}$$

where,

$$\hat{\mathrm{T}} = \left[1 + (1-t)^{\alpha/(1-\alpha)}\right]^{s(1-\alpha)/\alpha}$$
$$D = \phi^{\eta s/\varepsilon} \left(\alpha\, s/\varphi\, c\right)^{s} (1-s)^{(1-s)}$$

Welfare changes will depend on changes in factor prices and in consumer surplus. The change in consumer surplus is composed of the change in the prices of differentiated products (price effect), and of the change in the number of varieties available for consumption (variety effect). The price effect is captured by $\hat{\mathrm{T}}$, and the variety effect by the number of firms.

4.1. **Iceberg Trade Costs**

With no change in sectoral output and thus no change in factor prices or firm numbers, iceberg trade costs enable the isolation of the price effects. The decline in trade costs implies a reduction in the price of imports which increases consumer surplus ($-\partial\hat{\mathrm{T}}/\partial t > 0 \,\forall\, \alpha$). The more inelastic is demand for differentiated products, i.e. for smaller values of α, the greater the gain from the reduction in prices ($-\partial\hat{\mathrm{T}}/\partial\alpha > 0$). Both factors will gain from trade liberalisation and the extend of the gain will depend on the degree to which products are differentiated. This is the force underlying Krugman's conclusion that factors are more likely to gain from trade the greater the degree of product differentiation.

4.2. **Ad Valorem Trade Costs**

As well as the price effects there will now be factor price and variety effects. Factor prices change non-monotonically, as seen above. Changes in variety will depend on changes in firms numbers. From (12) it can be seen that output per firm is constant. Hence, the sectoral changes in output as previously outlined will be reflected in changes in the number of firms.

The non-monotonicity of both factor prices and firm numbers implies that in the move from some trade costs to freer trade either factor may experience a decline in welfare. At higher levels of trade costs the changes in wages and numbers of firms act to decrease welfare for owners of labour, whilst the price effect acts to increase welfare; and at lower levels of trade costs welfare will be strictly increasing as trade is liberalised. Correspondingly for owners of capital at high levels of trade cost, changes in factor prices and in the price effect will act to increase welfare, whilst changes in variety will decrease welfare. At lower levels of trade costs the factor price effect will be negative, whilst both the variety and price effect will be positive.

The net effect will depend on the relative strength of the three effects and may result in a decrease in welfare for either factor as trade is liberalised. The extent of this will depend on relative factor intensities and on the elasticity of demand for differentiated products. Figure 2 simulates the reduction in trade costs and traces the path of welfare for owners of capital and owners of labour as a proportion of welfare at autarky.

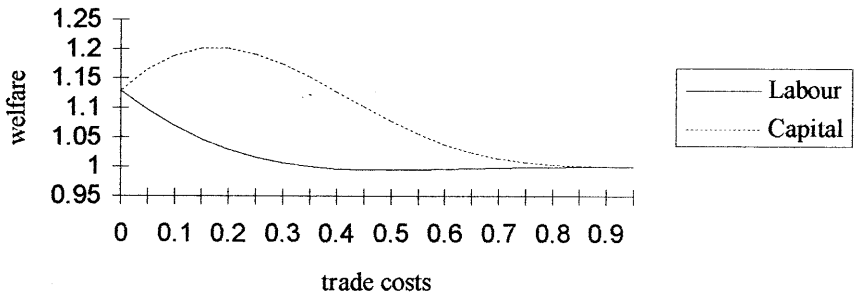

FIGURE 2

Changes in Welfare for Labour and Capital

From figure 2 it can be seen that the factor used intensively in the imperfectly competitive sector experiences a decline in welfare at high levels of trade costs, whilst the other factor at lower levels. Indeed as we move from some trade costs to free trade there is a significant decline in the welfare of the factor intensive in the perfectly competitive sector. Where trade costs are tariffs, with tariff revenue returned to each factor on a per capita basis then, as discussed in section 3.3, sectoral changes follow the same pattern as ad valorem trade costs, but because of the additional income effects, are less pronounced. As above either factor may experience a decline in welfare as trade is liberalised.

5 Factor Prices and Welfare for Non-Identical Economies [4]

Countries are now allowed to differ in their relative factor endowments. The difference is constructed in such a way that the world stock of capital and labour is held constant. Where the world stock of capital and labour is equal to K and L, country endowments are given by,

$$\begin{cases} L_1 = (1-m)\,L; & K_1 = mK \\ L_2 = mL; & K_2 = (1-m)\,K \end{cases} \tag{26}$$

where $0 < m < 1$. For the remainder of the discussion it is assumed that $m < 0.5$ so that country 1 is labour abundant and country 2 capital abundant.

5.1. Distribution of Welfare Gains across Factors

With differences in factor endowments there will be both intra- and inter-industry trade and thus Stolper-Samuelson effects as trade is liberalised.

4. In this section the discussion focusses on changes in ad valorem trade costs only.

Following the same prodedure as before (see equation 15), solving for autarky and free trade wages, and comparing yields,

$$\text{(27)} \qquad \begin{cases} w_1^A/w_2^A = (m/(1-m))^{2\varepsilon} \\ w^{FT}/w_1^A = ((1-m)/m)^{\varepsilon} \\ w^{FT}/w_2^A = (m/(1-m))^{\varepsilon} \end{cases}$$

where subscripts refer to countries and superscripts A and FT to autarky and free trade levels respectively. The Stolper-Samuelson effects of trade can now be seen. The price of the scarce factor will be higher at autarky in each country; trade liberalisation leads to factor price equalisation; hence the price of the factor used intensively in the production of the net traded good rises, and the price of the other factor falls in each country.

The effects on welfare of reductions in trade costs can be decomposed into three elements – Stolper-Samuelson effects, factor price changes arising from the change in the trading resource sector, and changes in consumer surplus. If the Stolper-Samuelson effect is sufficiently strong then, as in the traditional trade model, the scarce factor will suffer a welfare loss in moving from autarky to free trade. The closer are domestic factor endowments to world endowments the more important will be the variety effects. As with KRUGMAN [1981] the more dissimilar are the economies the more likely it is that in each country one of the factors will lose from trade, and this is despite the sum of the other two effects. Figure 3 depicts the changes in welfare as a proportion of autarky welfare for each factor in each country where products are scarcely differentiated ($\alpha = 0.975$), and where $m = 0.4$.

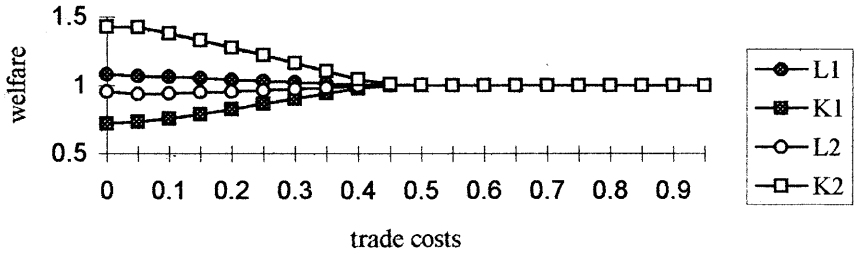

FIGURE 3

Change in Welfare for Non-Identical Economies (alpha = 0.975)

The Stolper-Samuelson effect can be clearly seen. Welfare of the scare factor in each country (L2, K1) falls, and conversely for the other factor (L1, K2). Where products are more differentiated, however, the consumer surplus and factor price changes may mitigate against this outcome. This can be seen in Figure 4.

It is now possible that in the move from some trade costs to free(er) trade that the scarce factor may experience an increase in welfare, and that the abundant factor will experience a decrease. For example, capital is

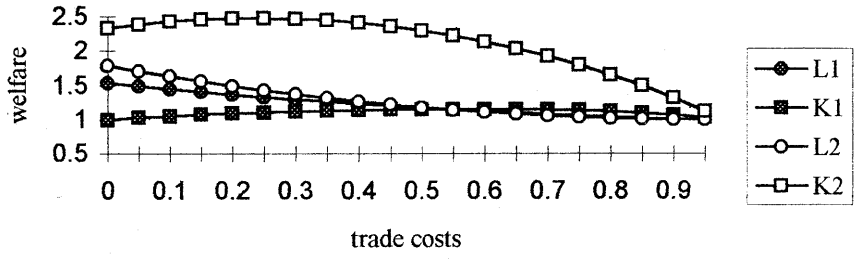

FIGURE 4

Change in Welfare: Non-Identical Economies (alpha = 0.5)

the abundant factor in country 2 yet experience a decline in welfare in the move from some trade costs to free trade. Similarly labour in country 2 experiences a rise in welfare despite being the scarce factor.

5.2. **Overall Welfare Gains**

Comparing overall autarky and free trade welfare levels for each country yields:

$$
\text{(28)}\qquad
\begin{cases}
\dfrac{V_1^{FT}}{V_1^{A}} = \left(\dfrac{1-m}{m}\right)^{B}\left[\dfrac{(1-m)^{\eta-1}}{m^{\eta}}\right]^{\frac{s(1-\alpha)}{\alpha}} \\
\qquad\qquad \times\left[\dfrac{(1-m)(1-B)+mB}{1-m}\right] > 1 \\
\dfrac{V_2^{FT}}{V_2^{A}} = \left(\dfrac{m}{1-m}\right)^{B}\left[\dfrac{m^{\eta-1}}{(1-m)^{\eta}}\right]^{\frac{s(1-\alpha)}{\alpha}} \\
\qquad\qquad \times\left[\dfrac{m(1-B)+(1-m)B}{m}\right] > 1
\end{cases}
$$

where as previously, $B = \varepsilon + s(\eta - \varepsilon)$. For each country overall welfare will always be higher with free trade than under autarky. This arises from the improvement in resource allocation according to comparative advantage and from the increased consumption of differentiated products. Moreover, as in Lawrence and Spiller, the size of the welfare gain, for a given size of the world economy, increases with the difference in endowments.

However, the relative gain across countries changes with the difference in endowments.

$$
\text{(29)}\qquad
\frac{V_1^{FT}/V_1^{A}}{V_2^{FT}/V_2^{A}} = \left[\frac{1-m}{m}\right]^{2B}\left[\left(\frac{1-m}{m}\right)^{2\eta-1}\right]^{\frac{s(1-\alpha)}{\alpha}} \times\left[\frac{(1-m)m(1-B)+m^2B}{(1-m)m(1-B)+(1-m)^2B}\right]
$$

If $m = 0.5$ then (29) is equal to one and the welfare gain is the same for each which is as expected for the countries are now identical in all respects. If $m < 0.5$ then each of the terms in square brackets is less than 1, which implies that the welfare gain for country 2 is greater, and this disparity widens as factor endowment differences increase. This occurs because as country 1 becomes relatively more labour abundant the number of varieties produced in the imperfectly competitive sector increases, and conversely for country 2. There are now greater gains from trade liberalisation for country 2 as it achieves access to a larger variety of products; and the reverse applies to country 1. This can also be seen in Figure 4 which shows that the greatest welfare gain is experienced by factors of production in country 2, which has a comparative advantage in the perfectly competitive sector.

This suggests that the incentives to trade liberalisation may vary depending on countries' factor endowments. However, this arises not from Stolper-Samuelson considerations but from the welfare gains achieved by increased consumption of differentiated products. In particular the country with a comparative advantage in perfectly competitive sector products has the larger incentive to pursue trade liberalisation. Hence, while there are clearly gains from trade, the incentives for trade liberalisation may be asymmetric, and are greatest for those countries with the smaller imperfectly competitive sector at autarky. Analogously, with identical capital-labour ratios but differences in size, the benefits from liberalisation would be greater for the smaller country.

6 Conclusions

This paper has focused on the effects on factor prices and welfare of partial trade liberalisation. Given the unambiguous, and for many countries substantial, level of trade/transport costs, their explicit consideration is of some importance. Nevertheless, the results presented here are based on a theoretical model and should not be taken to apply directly to the real world. Where KRUGMAN's [1981] results suggest that with two identical economies both factors will unambiguously gain from trade, it was shown that this is only true when comparing free trade with autarky equilibria. Instead, for each of the factors factor prices and welfare are likely to change non-monotonically and this will depend upon the factor intensity of the trading resources sector. It is only in the special case where the factor intensity of this sector is exactly the same as the sector in which there are trade costs that there would be no changes in factor prices and that welfare for each factor rises monotonically. Allowing for differences in factor endowments introduces Stolper-Samuelson effects which may dominate the non-monotonicity previously outlined. Nevertheless, it is no longer unambiguously true that the abundant factor will gain from the freeing of trade. Moreover, introducing factor endowment differences changes the relative incentives for trade liberalisation; where it is the country with the comparative advantage in the perfectly competitive sector which gains the most from trade liberalisation.

APPENDIX

• Solving for factor prices (iceberg trade costs)

With countries identical in every respect, $p_{11} = p_{22}$; $p_{12} = p_{21}$; $n_1 = n_2$. Using this in (5) and substituting into (6) gives,

(A1) $$\sum_j x_{ij} = I_i\, s / n_i\, p_{ii}$$

setting A1 equal to equation (12), substituting (11), and rearranging yields,

(A2) $$\frac{f}{(1-\alpha)} = \frac{I_i\, s}{n_i\, A_i}$$

Substituting equation (12) in (13) and using A2 gives,

(A3) $$w_i\, L_i = Z_i\,(1-\varepsilon) + (1-\eta)\, I_i\, s$$

(A4) $$r_i\, K_i = Z_i\, \varepsilon + \eta\, I_i\, s$$

Solving A4 for Z_i, and substituting in A3, as well as using equation (14) gives,

(A5) $$\frac{w_i}{r_i} = \frac{K_i}{L_i}\left[\frac{1-\varepsilon-s\,(\eta-\varepsilon)}{\varepsilon+s\,(\eta-\varepsilon)}\right] = \frac{K_i}{L_i}\left[\frac{1-B}{B}\right]$$

Equation (8) can then be used to solve for either factor price. The same procedure can be employed for ad valorem trade costs, or tariffs. Where countries are of different size A5 gives the factor price ratio at both autarky and free trade.

• Solving for Firm Numbers

Substituting equation (12) into (13) gives,

(A6a) $$L_i = \frac{Z_i\,(1-\varepsilon)}{w_i} + \frac{n_i^{\gamma+1}\,(1-\eta)\, A_i\, f}{w_i\,(1-\alpha)}$$

(A6b) $$K_i = \frac{Z_i\, \varepsilon}{r_i\,(w_i)} + \frac{n_i^{\gamma+1}\, \eta\, A_i\, f}{r_i\,(w_i)\,(1-\alpha)}$$

Solving A6b for Z_j, substituting into A6a and rearranging gives,

(A7) $$n_i = \frac{(1-\alpha)}{f A_i\,(n-\varepsilon)}\left[r_i\, K_i\,(1-\varepsilon) - w_i\, L_i\, \varepsilon\right]$$

For autarky and free trade values of n, A5 can be substituted into yield,

$$n_i = \frac{L_i\, s\,(1-\alpha)}{f\,\phi\,(1-B)} \left[\frac{1-B}{B}\right]^{\eta} \left[\frac{K_i}{L_i}\right]^{\eta} \tag{A8}$$

• Solving for Welfare

The indirect utility function is given by (20). With identical countries, firm numbers, domestic prices, and trade-cost inclusive prices are identical. Therefore,

$$Q_i^{-s} = n_i^{s(1-\alpha)/\alpha}\, p_{ii}^{-s} \left[1 + (1-t_{ij})^{\alpha/(1-\alpha)}\right]^{s(1-\alpha)/\alpha} \tag{A9}$$

Substituting (11) into A9; and allocating income to factors yields equation (21).

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