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Globalisation and Factor Returns in Competitive Markets

By R. Falvey and U. Kreickemeier

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GLOBALISATION AND FACTOR RETURNS IN COMPETITIVE MARKETS

by

R. Falvey and U. Kreickemeier

Abstract

The standard competitive trade model, extended to include many goods and factors, is used to establish two results. First, integration of goods markets decreases on average international disparities in the real returns of internationally immobile factors, irrespective of whether there is international factor mobility or not. Second, integration of factor markets has the same effect, and this result holds in the presence of nontraded goods. We conclude that globalisation, a process of increasing freedom for international movements of goods and factors, will tend to reduce international disparities in the real returns to factors.

JEL classification: F11, F16

Keywords: Factor Mobility, Factor Real Returns, Non-traded Goods

Outline

Non-Technical Summary

The ongoing debate over the causes of the shifts in relative returns to skilled and unskilled labour in developed countries has drawn attention to the impact of "globalisation" on national factor markets. National and international markets have become increasingly linked through the movement of goods, factors of production and individuals (acting as both workers and consumers) among countries. These movements are usually prompted by differences in prices and returns, which they will tend to remove.
As yet this process is not all encompassing, however, and some factors and goods remain non-traded (internationally immobile). Questions then arise concerning the implications of (expanding) international goods and factor mobility for international disparities in the real returns of immobile factors. How does globalisation in its various forms affect the relative international position of the non-participating factors? Here we investigate this issue using the standard multi-sector competitive model of international trade.

We restrict attention to cases where countries differ only in their factor endowments (i.e. technologies and preferences are identical internationally), so that countries are "defined" by their endowments of internationally immobile factors. Our aim is to investigate the implications of three aspects of globalisation for international disparities in the real returns to internationally immobile factors. These are (a) the presence of non-traded goods; (b) the presence of international factor mobility (investment or migration); and (c) the presence of consumer migration (which equalises the cost of living across countries). We establish two main results. First, integration of goods markets decreases on average international disparities in the real returns of internationally immobile factors, irrespective of whether there is international factor mobility or not. Second, integration of factor markets has the same effect, and this result which has been established earlier for the case of existing free goods trade, holds in the presence of nontraded goods. Thus globalisation, a process of increasing freedom for international movements of goods and factors, will tend to reduce international disparities in the real returns to internationally immobile factors, irrespective of the sequence in which the steps of integration take place.

1 Introduction

The ongoing debate over the causes of the shifts in relative returns to skilled and unskilled labour in developed countries has drawn attention to the impact of "globalisation" on national factor markets. National and international markets have become increasingly linked through the movement of goods, factors of production and individuals (acting as both workers and consumers) among countries. These movements are usually prompted by differences in prices and returns, which they will tend to remove. As yet this process is not all encompassing, however, and some factors and goods remain non-traded (internationally immobile). Questions then arise concerning the implications of (expanding) international goods and factor mobility for international disparities in the real returns of immobile factors. How does globalisation in its various forms affect the relative international position of the non-participating factors? Here we investigate this issue using the standard multi-sector competitive model of international trade.

We restrict attention to cases where countries differ only in their factor endowments (i.e. technologies and preferences are identical internationally), so that countries are "defined" by their endowments of internationally immobile factors. Our aim is to investigate the implications of three aspects of globalisation for international disparities in the real returns to internationally immobile factors. These are (a) the presence of non-traded goods; (b) the presence of international factor mobility (investment or migration); and (c) the presence of consumer migration (which equalises the cost of living across countries). We establish two main results. First, integration of goods markets decreases on average international disparities in the real returns of internationally immobile factors, irrespective of whether there is international factor mobility or not. Second, integration of factor markets has the same effect, and this result which has been established earlier for the case of existing free goods trade, holds in the presence of nontraded goods. Thus globalisation, a process of increasing freedom for international movements of goods and factors, will tend to reduce international disparities in the real returns to internationally immobile factors, irrespective of the sequence in which the steps of integration take place.

The link between trade in goods and international differences in factor returns has always been of interest to trade economists. In the context of the competitive model employed here, the focus has often been on establishing conditions for free trade in goods to lead to full international factor price equalisation (see, for example, Dixit and Norman, 1980; Woodland, 1982; Blackorby et al, 1993, and Deardorff, 1994). Where countries have identical technologies and preferences, this outcome depends on the relative numbers of internationally traded goods and internationally immobile factors. If the number of traded goods equals the number of immobile factors, then factor price equalisation can be a characteristic of the non-specialised trading equilibrium. If the number of traded goods exceeds the number of immobile factors, there is a problem of indeterminacy in the international location of production, and trade can lead to factor price divergence (Deardorff, 1986). Where the number of internationally immobile factors exceeds the number of traded goods, the production outcome is determinate, and factor returns will not be equalised by goods trade in general. This is the structure we employ here.

The arguably most important contribution to this this strand of the literature is Neary (1985). He shows in a framework similar to ours that international factor mobility tends to reduce international disparities in the returns of the immobile factors. Neary (1985) focuses on nominal returns, assuming that all goods are traded. Clearly, allowing for the mobility of a sufficient number of factors can induce factor price equalisation for the immobile factors (Neary, 1985). In the analysis below we assume that the number of internationally immobile factors is sufficiently large (relative to the number of traded goods) for production to be determinate and free "trade" in goods and factors not to induce full factor price equalisation. Our main contribution with the present paper is to focus on factor real returns in the presence of nontraded goods rather than assuming that all goods are freely traded and focus on nominal factor returns. To put it differently, while Neary (1985) derives results for a world with fully integrated goods markets and then goes on to assess the difference that factor market integration makes, we derive results for the case with less than perfectly integrated goods and factor markets. A first step in this direction has been undertaken by Falvey (1999) who compares a free trade regime with restricted trade but neither considers different degrees of goods market integration nor international factor mobility.

As has been pointed by Dixit and Norman (1980, p. 102) for the case of nominal returns, it is not possible for the general production structure employed here to derive results for arbitrarily large endowment differences. The same argument applies to the case of real returns we are interested in. Therefore, we follow Neary (1985) and concentrate on small differences in the relative factor endowments between countries.

In outline the remainder of this paper is as follows. The next section sets up the model in the most familiar case where all goods are traded, allowing for international mobility of some of the factors. Factor endowment differences generate international disparities in factor returns that are negatively correlated with the endowment differences. This correlation is preserved but weakened in the presence of international factor mobility. Section 3 then considers the case where some of the goods are non-traded, but all factors are internationally immobile. The standard reciprocity relations, which link changes in outputs and nominal (numeraire) factor returns, can be extended to link excess supplies and factor real returns. International disparities in factor real returns can then be shown to decrease with a decrease in the number of non-traded goods. Section 4 combines the previous cases, allowing for factor mobility in the presence of non-traded goods. The existence of non-traded goods requires us to distinguish international migration, where the factor owner must move with the factor, from factor investment, where the factor owner need not move. Factor migration responds to international differences in mobile factor real returns, while factor investment responds to international differences in the nominal (numeraire) returns of the mobile factors. We show that both types of factor mobility lead to a decrease in the real returns of the non-participating factors. Section 5 allows "consumer migration", where international expenditure flows arbitrage away international differences in the cost of living (but not international differences in individual non-traded goods prices). Although this removes international price differences "on average", international disparities in factor returns are still higher than if all goods were traded. Section 6 concludes.

2 Factor Returns under Free Trade

Consider a two country world, where a small (home) and a large (foreign) trading economy produce and consume $Q + 1$ goods using R factors under CRS production technologies.[1] We begin by assuming that all factors are internationally immobile, and that all goods are tradable. In the small economy, domestic demand can be represented using that economy's expenditure function $E(p, u)$, where u denotes the welfare of a "representative individual" and p is a $Q+1$ column vector of domestic prices ($p_j, j = 0, \ldots, Q$) with good 0 acting as numeraire ($p_0 \equiv 1$).[2] The derivatives of E with respect to product prices yield the compensated demand vector $E_p(p, u)$. Domestic supply can similarly be represented using the economy's Gross National Product

[1]The small/large country combination simplifies the presentation of the results that follow, but they can readily be extended to two large trading economies following the approach of Dixit and Woodland (1982), Svensson (1984) and Svensson and Markusen (1985). Assuming the economy's production possibility set is convex and exhibits CRS allows for joint production, intermediate goods and any pattern of factor mobility among sectors within the economy.

[2]The expenditure function is concave and linearly homogeneous in prices, and increasing in utility. It is also assumed to be twice continuously differentiable.

function $G(p, V)$, where V is the R column vector of factor endowments.[3] The derivatives of this function with respect to product prices and factor endowments yield, respectively, the economy's supply vector $G_p(p, V)$ and its vector of factor returns $w = G_V(p, V)$.

The large (foreign) country has the same structure, and its variables are denoted with an asterisk. Initially both countries are identical, except for scale. In addition, consumers in both countries have identical homothetic preferences. Then $p = p^*$, $w = w^*$, V is proportional to, but much smaller than, V^*, and there is no international trade. For notational convenience we normalise units so that p^*, and hence p initially, is a unit vector.

Suppose that, starting from the initial equilibrium described above, there is a small change (dV) in the home endowment vector. Since the home country is small world prices are unaffected, but now the difference in relative endowments provides a basis for trade. For given product prices, the corresponding change in factor (real and numeraire) returns, are given by[4]

$$dw = G_{VV} dV \tag{1}$$

In general, little can be said about the international differences in individual factor returns. But the matrix G_{VV} is negative semidefinite, and hence, given that dV is not proportional to V,[5] there is a negative "correlation" between the differences in relative endowments between the large and the small country and differences in factor returns - i.e.

$$dV' dw = dV' G_{VV} dV < 0 \tag{2}$$

Since product prices are unchanged, there must be (cost-offsetting) increases in some factor returns and decreases in others. Otherwise price would depart from average cost. So allowing for a difference in relative factor endowments will tend to reduce some factors' returns and increase others'. Equation (2) indicates that in comparison with the rest of of the world the home country has "on average" a lower return to those factors with which it is relatively well endowed. We follow Dixit and Norman (1980, p. 102) in interpreting

[3] The GNP function is convex and linearly homogeneous in product prices and concave and linearly homogeneous in factor endowments. Where the GNP function is also assumed to be twice continuously differentiable we require that the number of factors exceeds the number of final goods, or, if there is joint production, the number of productive activities.

[4] If the number of goods ($Q + 1$) equals the number of factors (R), and the change in V does not move the home country out of its 'cone of diversification' at these world prices, then FPE holds and G_{VV} is a zero matrix. In this case the difference in relative endowments alone would generate no international disparities in factor returns.

[5] If dV is proportional to V, all outputs adjust in the same proportion and there is no change in factor returns at the given product prices.

the magnitude of this correlation as the appropriate indicator of general international differences in factor returns when there are many goods and factors.

Now assume, as in Neary (1985), that all goods continue to be traded but in addition there is international mobility of some of the factors of production. Under free trade and the assumed absence of terms of trade effects, international migration and international investment have identical effects on factor prices, and therefore are not distinguished. The vector V is separated into the two disjoint components L (internationally immobile) and K (internationally mobile). We assume that $G(p, L, K)$ is strictly concave in each K and L separately, so that both G_{KK} and G_{LL} are negative definite. The questions to be answered here are the following: First, given the international mobility of K, is there still a negative correlation between dL and dw_L? Second, is it possible to say something on the relative size of this correlation with and without factor mobility?

In general, the domestic country and the rest of the world differ in their endowments of mobile and immobile factors. It is possible, however, to focus on international differences in the endowment of L, as the following argument shows: As prices for K are determined in the large foreign country, K can be interpreted as a single composite factor with the weights of its single components given by the factor prices in the rest of the world. Denoting the composite factor by $\mathcal{K}$ and the resulting $(L+1) \times 1$ vector $(\mathcal{K}, L)'$ by $\mathcal{V}$, every difference in relative international factor endowments can be expressed as

$$d\mathcal{V} = \frac{d\mathcal{K}}{\mathcal{K}} \begin{pmatrix} \mathcal{K} \\ L \end{pmatrix} + \begin{pmatrix} 0 \\ dL \end{pmatrix}$$

The first term, denoting a proportional change in all factor endowments (including the composite factor) has no influence on factor prices and can therefore be ignored in the following. The focus is on the residual difference dL, keeping in mind that it is measured in comparison to international endowment differences of the composite factor.[6]

International differences in factor prices for L depend on international differences in *employment* (rather than endowment) of L and K, where the latter is endogenous and denoted by $d\widetilde{K}$. In analogy to (1), the international differences in factor prices are

$$\begin{aligned} d\widetilde{w}_L &= G_{LL} dL + G_{LK} d\widetilde{K} \\ d\widetilde{w}_K &= G_{KL} dL + G_{KK} d\widetilde{K} = 0 \end{aligned} \tag{3}$$

[6]Jones (1974) has emphasized the usefulness of the Hicksian composite commodity theorem in international trade theory. See also Cornes (1992, pp. 189-92).

where G_{ij} are the appropriate submatrices of G_{VV}. Solving the second equation for $d\widetilde{K}$ and inserting into the first one, premultiplied by dL', gives

$$dL'd\widetilde{w}_L = dL'\widetilde{G}_{LL}dL \tag{4}$$

with $\widetilde{G}_{LL} \equiv G_{LL} - G_{LK}G_{KK}^{-1}G_{KL}$ being negative semidefinite. Hence, as shown by Neary (1985), the negative correlation between endowment of immobile factors and their factor prices is preserved in the presence of factor mobility. Comparing the correlations with and without factor mobility gives

$$dL'dw_L - dL'd\widetilde{w}_L = dL'G_{LK}G_{KK}^{-1}G_{KL}dL \leq 0 \tag{5}$$

and hence the correlation is algebraically larger, i.e. smaller in absolute value, if there is factor mobility. Again, this result has been derived by Neary (1985) and serves as a point of reference for the analysis to follow.[7]

3 Non-traded goods

We now suppose that some goods are not tradable, and divide the set of goods into $n \in N$ non-traded and $t \in T$ traded goods (including the numeraire).[8] In this section we focus on the case where all factors are internationally immobile, introducing factor mobility in the next section. Let p_N denote the vector of non-traded goods prices, and p^* the vector of traded goods prices. Market clearing for the N non-traded goods requires

$$E_N(p_N, p^*, u) - G_N(p_N, p^*, V) = 0,$$

where in order to simplify notation, subscript N denotes derivatives with respect to the nontraded goods' prices. Differentiating totally these market clearing conditions gives

$$dp_N = M_N^{-1}(G_{NV}dV - e_N E_u du) \tag{6}$$

where $M_N \equiv E_{NN} - G_{NN}$ is the substitution matrix among nontraded goods. We assume that there is some substitutability between traded and nontraded goods, in which case M_N is negative definite (Dixit and Norman 1980, p. 130). The column vector e_N has as its nth element e_n $(n \in N)$ the marginal

[7] This result is subject to the well known qualification, which equally applies to all the results derived below, that the matrices involved be evaluated at the same point. Hence, as mentioned in the introduction, all our results are of a local nature.

[8] See Neary (1988) for a general discussion of the determinants of a relative price index of nontraded goods (the "real exchange rate") in this type of framework.

propensity to spend on non-traded good n. The term in brackets on the right hand side of this equation represents the change in net supplies of the non-traded goods at the initial prices.

Without international movement of factors or consumers, domestic income equals domestic expenditure, and therefore

$$E_u du = G_V' dV \tag{7}$$

at the initial prices p. Substituting (7) into (6) gives

$$dp_N = M_N^{-1}(G_{NV} - e_N G_V')dV \tag{8}$$

with the matrix $(G_{NV} - e_N G_V')$ giving the net effect of the change in the endowment vector on excess supplies of the nontraded goods at initial prices.

Now consider the effects of the endowment change on factor returns. Including the effects of price changes, (1) becomes

$$dw = G_{VN} dp_N + G_{VV} dV \tag{9}$$

But dw in (9) simply represents the change in home factor returns measured in units of the numeraire good. With the domestic prices of non-traded goods changing, (9) no longer gives the change in factor real returns (dW), where $W = w/P$ and

$$P = \sum_{j=0}^{Q} p_j e_j$$

with e_j denoting the average expenditure share for good j. By the assumption of homothetic tastes, average expenditure shares equal marginal expenditure shares, and hence the same variable is used for both. Since all prices have been normalized to unity initially, $P = \sum_{j=0}^{Q} e_j = 1$ initially also. Then, the change in factor real returns is

$$dW = dG_V - G_V dP \tag{10}$$

where $dP = e_N' dp_N$ since tradables prices are unchanged. Substituting for dP and dG_V gives

$$dW = (G_{VN} - G_V e_N')dp_N + G_{VV} dV \tag{11}$$

Equation (11) gives the relationship between endowment and domestic price changes and factor real returns in this small economy. To obtain the full effect of the endowment change on factor real returns, we substitute for dp_N from (8) in (11), yielding

$$dW = (\Gamma_{VV} + G_{VV})dV \qquad (12)$$

with $\Gamma_{VV} \equiv (G_{VN} - G_V e'_N)M_N^{-1}(G_{NV} - e_N G'_V)$ being a negative semi-definite matrix.[9] As marginal expenditure shares equal average expenditure shares due to homothetic preferences, one can state amended reciprocity relations which are responsible for Γ_{VV} being a negative semi-definite matrix: If

(i) an increase in the endowment of factor i leads to an excess supply (demand) of nontraded good k, then

(ii) the induced decrease (increase) in the price of good k leads to a decrease in the real return to factor i.

While in (i) it is the marginal expenditure shares which are relevant, in (ii) it is the average expenditure shares.[10]

For non-proportional endowment differences we then have

$$dV'dW = dV'(\Gamma_{VV} + G_{VV})dV < 0, \qquad (13)$$

showing that there is a negative correlation between relative factor endowments and disparities in factor real returns, just as is the case with relative factor endowments and disparities in numeraire returns in the model without nontraded goods. Comparing (13) to (2), we furthermore see that

$$dV'dW - dV'dw = dV'\Gamma_{VV}dV \leq 0 \qquad (14)$$

where the strict inequality holds if the endowment difference implies different nontraded goods prices in the two countries. We conclude that the international disparity in factor real returns is larger on average in the presence of some nontraded goods than under free trade.[11] Falvey (1999) has shown that in the present framework protective tariffs on some or all of the tradables

[9] In the borderline case, $(G_{N_iV} - e_{N_i}G'_V)dV = 0 \; \forall i$, i.e., the endowment change is such that there arises no excess supply or demand for any of the nontraded goods at the initial prices. Note that this is true for, but with more factors than goods is not restricted to, the case of proportional endowment changes.

[10] The assumption of identical and homothetic tastes rules out certain paradoxical outcomes. For example, Neary (1989) illustrates circumstances under which an inflow of migrants can raise an economy's real wage when some goods are nontraded and tastes are not identical and homothetic.

[11] Using (8) and (9), one can easily show that this is not necessarily true for nominal factor returns.

increase international disparities in factor real returns. The result stated in (14) can be seen as a special case where tariffs on some goods are prohibitive while being zero for all other goods.

Given that free trade in the absence of any nontraded goods should be seen as a reference scenario rather than a realistic possibility, it would be interesting to compare two situations with different strictly positive numbers of nontraded goods. To this end, the set of nontraded goods N is divided into the disjoint sets N_1 and N_2, and we compare a situation where all goods $n \in N$ are nontraded with a situation where only the smaller number $n_1 \in N_1$ is nontraded. In the latter case, the international disparity in factor real returns is given by

$$dV'dW^1 = dV'(\Gamma^1_{VV} + G_{VV})dV \tag{15}$$

where

$$\Gamma^1_{VV} \equiv (G_{VN_1} - G_V e'_{N_1})M_{11}^{-1}(G_{N_1V} - e_{N_1}G'_V)$$
$$M_N \equiv \begin{pmatrix} M_{11} & M_{12} \\ M_{21} & M_{22} \end{pmatrix}$$

Using a lemma from Diewert (1981, p. 78), and remembering that M_N is negative definite, we have

$$dV'dW - dV'dW^1 = dV'(\Gamma_{VV} - \Gamma^1_{VV})dV \leq 0 \tag{16}$$

and hence decreasing the number of nontradables decreases the international disparities in factor real returns.

4 International Factor Mobility

In this section we allow for international mobility of some factors of production, but retain the assumption that some of the goods are nontraded. With nontraded goods, we must make a distinction between *factor investment* and *factor migration.*[12] Under the latter, the countries of residence and employment coincide for the migrating factors, hence the migrants are concerned with real returns. International investors, on the other hand, respond to differences in numeraire returns as the country of residence (where their spending takes place) differs from the country where their factors are employed. In order to simplify notation, let $A_Z \equiv (G_{NZ} - e_N G'_Z)$, $Z = K, L$, denote the influence of a change in employment of factor Z on the excess

[12] See Dixit and Norman (1980).

supplies of nontradables. Consequently, A'_Z gives the effect of a change in p_N on the real return for factor Z. As in section 2, it is warranted in the following to focus on differences in endowments of immobile factors because internationally mobile factors can be treated as one composite factor.[13] In the absence of any factor movements, the analogous equation to (12) is

$$dL' dW_L = dL'(\Gamma_{LL} + G_{LL})dL < 0 \tag{17}$$

where Γ_{LL} is the appropriate submatrix of Γ_{VV}.

4.1 Factor Migration

Factor migration equalizes the real prices of the mobile factors; in analogy with (3), we have

$$d\widetilde{W}_K = G_{KL}dL + G_{KK}d\widetilde{K} + A'_K dp_N = 0 \tag{18}$$

$$d\widetilde{W}_L = G_{LL}dL + G_{LK}d\widetilde{K} + A'_L dp_N \tag{19}$$

The international difference in the prices of non-traded goods is given, in analogy to (8), by

$$dp_N = M_N^{-1}(A_L dL + A_K d\widetilde{K}) \tag{20}$$

Now, one has to substitute from (18) and (20) for the two endogenous variables in (19), namely dp_N and $d\widetilde{K}$. There are two equivalent ways of doing this. First, one can show that

$$d\widetilde{W}_L = (\widetilde{G}_{LL} + \widetilde{A}'_L \widetilde{M}_N^{-1} \widetilde{A}_L)dL \tag{21}$$

where $\widetilde{A}_L \equiv A_L - A_K G_{KK}^{-1} G_{KL}$ and $\widetilde{M}_N \equiv M_N + A_K G_{KK}^{-1} A'_K$ differ from A_L and M_N, respectively, by the effects of the induced change in domestic employment of the mobile factors. One can see that this employment change has both a supply side and a demand side effect. Clearly, this is due to the fact that the owners of the mobile factors are assumed to move together with the factors they supply. The matrix $\widetilde{M}_N$ is negative definite, and hence

[13] In the case of international investment, the reasoning from section 2 applies without any modifications. With international migration, the nominal factor price vectors for the mobile factors differ between the countries in general, but are proportionate to each other. Hence, as the relative prices of the migrating factors are the same in both countries, the composite commodity theorem can still be applied.

$\widetilde{A}'_L \widetilde{M}_N^{-1} \widetilde{A}_L$ is either negative semidefinite (with $L > N$) or negative definite (otherwise).[14] Alternatively, we have

$$d\widetilde{W}_L = (G_{LL} + \Gamma_{LL} - \widetilde{G}_{LK} \widetilde{G}_{KK}^{-1} \widetilde{G}_{KL}) dL \qquad (21')$$

with $\widetilde{G}_{KL} \equiv G_{KL} + \Gamma_{KL}$ and $\widetilde{G}_{KK} \equiv G_{KK} + \Gamma_{KK}$.[15] Premultiplying (21) by dL' gives

$$dL' d\widetilde{W}_L = dL' (\widetilde{G}_{LL} + \widetilde{A}'_L \widetilde{M}_N^{-1} \widetilde{A}_L) dL \leq 0, \qquad (22)$$

showing that the negative correlation between immobile factor real returns and differences in their endowments is preserved in the presence of international migration.

Furthermore, using (21) and (21′), respectively, and comparing these to (4) and (17), we find

$$\begin{aligned} dL'(dW_L - d\widetilde{W}_L) &= dL'(\widetilde{G}_{LK} \widetilde{G}_{KK}^{-1} \widetilde{G}_{KL}) dL \leq 0 \\ dL'(d\widetilde{W}_L - d\widetilde{w}_L) &= dL'(\widetilde{A}'_L \widetilde{M}_N^{-1} \widetilde{A}_L) dL \leq 0 \end{aligned} \qquad (23)$$

This leads to the inequality chain

$$dL' dW_L \leq dL' d\widetilde{W}_L \leq dL' d\widetilde{w}_L \qquad (24)$$

Hence, the international disparity in immobile factor real returns decreases if we allow for international migration of some factors, and it decreases further if we allow for more goods to become tradeable.

4.2 Factor Investment

As noted above, the distinguishing feature of factor investment lies in the fact that the owners of the factors do not move to the country of their investment. This implies that factor investment leads to the equalisation of nominal rather than real returns for the moving factors. In addition, changes in the domestic employment of the mobile factors have only a supply side effect while they influence domestic supply and demand if the owner moves together with the

[14] With $L > N$, it is possible that $\widetilde{A}_L dL = 0$, i.e., a change in the endowment of immobile factors preserves equilibrium in all nontraded goods markets at the initial prices.

[15] Equation (21) follows from solving (18) for $d\widetilde{K}$ and substituting into (20) and (19), then solving (20) for dp_N and substituting into (19). Equation (21′) follows from solving (20) for dp_N and substituting into (18) and (19), then solving (18) for $d\widetilde{K}$ and substituting into (19).

factor, i.e., in the factor migration case. The latter feature can be seen if we compare (20) with the analogous equation in the present context, which is

$$dp_N = M_N^{-1}(A_L dL + G_{NK} d\widetilde{K}) \tag{25}$$

The international factor price differentials for mobile and immobile factors are given by

$$dw_K = G_{KN} dp_N + G_{KL} dL + G_{KK} d\widetilde{K} = 0 \tag{26}$$

$$d\breve{W}_L = A_L' dp_N + G_{LL} dL + G_{LK} d\widetilde{K} \tag{27}$$

Now, we substitute from (25) and (26) for the two endogenous variables in (27), dp_N and $d\widetilde{K}$. There are, as in the case of factor migration, two equivalent ways of doing this. First one can show that

$$d\breve{W}_L = (\widetilde{G}_{LL} + \breve{A}_L' \breve{M}_N^{-1} \breve{A}_L) dL \tag{28}$$

where $\breve{A}_L \equiv A_L - G_{NK} G_{KK}^{-1} G_{KL}$ and $\breve{M}_N \equiv M_N + G_{NK} G_{KK}^{-1} G_{KN}$ differ from A_L and M_N, respectively, by the effects of the induced change in the domestic employment of the mobile factors. One can see that this employment change has only a supply side effect. While $\breve{M}_N$ is negative definite, $\breve{A}_L' \breve{M}_N^{-1} \breve{A}_L$ is negative semidefinite (with $L > N$) or negative definite (otherwise). The reasoning is analogous to the factor migration case. Alternatively,

$$d\breve{W}_L = (G_{LL} + \Gamma_{LL} - \breve{G}_{LK} \breve{G}_{KK}^{-1} \breve{G}_{KL}) dL \tag{28$'$}$$

with $\breve{G}_{KL} \equiv G_{KL} + G_{KN} M_N^{-1} A_L$ and $\breve{G}_{KK} \equiv G_{KK} + G_{KN} M_N^{-1} G_{NK}$.[16] Because of the negative definiteness of M_N, $\breve{G}_{KK}$ is negative definite. Premultiplying (28) by dL' gives

$$dL' d\breve{W}_L = dL' (\widetilde{G}_{LL} + \breve{A}_L' \breve{M}_N^{-1} \breve{A}_L) dL \leq 0, \tag{29}$$

showing that the negative correlation between factor real returns and endowment differences is preserved in the presence of international investment.

Furthermore, using (28) and (28′), respectively, and comparing these to (4) and (17), one can see that

$$\begin{aligned} dL'(dW_L - d\breve{W}_L) &= dL'(\breve{G}_{LK} \breve{G}_{KK}^{-1} \breve{G}_{KL}) dL \leq 0 \\ dL'(d\breve{W}_L - d\widetilde{w}_L) &= dL'(\breve{A}_L' \breve{M}_N^{-1} \breve{A}_L) dL \leq 0 \end{aligned} \tag{30}$$

[16] In analogy to the preceding section, (28) follows from solving (26) for $d\widetilde{K}$ and substituting into (25) and (27), then solving (25) for dp_N and substituting into (27). Equation (28′) follows from solving (25) for dp_N and substituting into (26) and (27), then solving (26) for $d\widetilde{K}$ and substituting into (27).

This leads to the inequality chain

$$dL'dW_L \leq dL'd\breve{W}_L \leq dL'd\widetilde{w}_L \tag{31}$$

which shows that there is a stepwise decrease in average international factor real return differentials as one allows for international investment first, and then increases the number of goods to be traded. This is analogous to the case of factor migration.

5 Consumer Migration

If nontraded goods prices differ across countries, then the cost of living is likely to differ across countries also. This generates consumption arbitrage opportunities for individuals whose income earning activities do not tie their consumption to a particular location.[17] If this group has sufficient expenditure, such arbitrage may effectively remove international differences in the cost of living. Note that we are restricting individuals to consuming their entire basket in a single location, rather than making individual purchases where prices are cheapest.[18] While this makes the nontraded goods prices identical across countries "on average", individual nontraded goods prices are not equalised - i.e. the goods remain "nontraded". There are two questions one might ask concerning the implications of consumer migration for international disparities in factor real returns. First, can we determine whether the combination of non-traded goods and consumer migration will yield higher or lower disparities than when all goods are traded? Second, can we determine whether consumer migration, by removing international differences in non-traded goods prices on average, tends to reduce the disparities in factor real returns?

Because of consumer migration, changes in domestic income do not equal the change in domestic demand, i.e. contrary to section 3 $E_u du \neq G'_V dV$ in general. Therefore, while (6) continues to hold, (8) does not. In equilibrium it must be the case that both countries have the same price index, i.e.

$$dP = e'_N dp_N = 0 \tag{32}$$

Substituting (6) into (32) and solving for $E_u du$ gives

$$E_u du = \Delta G_{NV} dV \tag{33}$$

[17]Examples may include those retired from working, capital-owners and absentee landlords.

[18]This can be compared with "tourist purchases" which can be made on a more selective basis. For an examination of tourism in this type of model see Copeland (1991).

with $\Delta \equiv (e'_N M_N^{-1} e_N)^{-1} e'_N M_N^{-1}$ being the multiplier which translates the change in the supply of nontraded goods into the change in expenditure required to keep P constant.[19] Substituting (33) back into (6) gives

$$dp_N = (\overline{M}_N)^{-1} G_{NV} dV \tag{34}$$

where $(\overline{M}_N)^{-1} \equiv M_N^{-1} - B$, and $B \equiv M_N^{-1} e_N \Delta$. As the matrix B is a quadratic form in the negative scalar $(e'_N M_N^{-1} e_N)^{-1}$, it is negative semi-definite. It is shown in the appendix that $(\overline{M}_N)^{-1}$, translating a change in excess supply at constant prices into a price change, is negative semi-definite as well.[20]

With no change in the domestic price index, the changes in factor real returns in the home country are given by

$$d\overline{W} = G_{VN} dp_N + G_{VV} dV \tag{35}$$

where the only difference to (9) lies in the determination of dp_N which in the present case is given by (34). Hence, for non-proportional differences in international factor endowments,

$$dV' d\overline{W} = dV'(G_{VV} + G_{VN}(\overline{M}_N)^{-1} G_{NV}) dV < 0 \tag{36}$$

and thus the negative correlation between factor real returns and endowment differences continues to hold with consumer migration. Comparing this case with the situation where all goods are traded (and hence there is no incentive for consumer migration), we have

$$dV'(d\overline{W} - dw) = dV' G_{VN} (\overline{M}_N)^{-1} G_{NV} dV \leq 0 \tag{37}$$

which answers the first question posed above: free goods trade (which equalizes all goods prices) leads to international factor price differentials which are smaller on average than in the presence of nontraded goods and consumer migration (which equalizes price indices only).

We turn now to the second question, that is the impact of consumer migration itself on international factor return disparities. Comparing (13) and (36), we find

$$dV'(dW - d\overline{W}) = dV'(A'_V B A_V) dV \leq 0, \tag{38}$$

[19] Note that with $N = 1$ the multiplier collapses to $1/e_N$.

[20] For the case $N = 1$, it follows that $(\overline{M}_N)^{-1} = 0$. Obviously, with a single nontraded good consumer migration, by equalising price indices, equalises the price of the nontraded good. With more than one nontraded good, consumer migration equalises price vectors p_N internationally if output differences at the initial prices are proportional to expenditure shares, i.e., if $G_{NV} dV = e_N \gamma$, where γ is some scalar. Then the change in domestic expenditure induced by consumer migration clears simultaneously all nontraded goods markets at the initial prices. The result can verified by substituting $e_N \gamma$ into (34).

where $A_V \equiv (G_{NV} - e_N G'_V)$.[21] Combining the (36) and (38) gives the inequality chain

$$dV'dW \leq dV'd\overline{W} \leq dV'dw \tag{39}$$

which shows that consumer migration leads to a decrease in international factor real return differentials on average, but by less than international trade in goods. This result indicates that consumer migration can only be an imperfect substitute for goods market integration, and the incentive disappears when goods markets are fully integrated. In contrast to this, there is an incentive for factors to move internationally for any degree of goods market integration, and allowing for factor mobility decreases further international differences in factor real returns for the immobile factors. In that sense, factor movements are an independent aspect of globalisation while consumer migration, responding to incomplete goods market integration, is not.

6 Conclusion

We have shown in a general competitive model with many goods and factors that globalisation, defined as increasing freedom in the international mobility of goods and factors, decreases on average international differentials of factor real returns for the non-participating factors. In particular, we have shown that any route taken towards a hypothetical scenario of "full globalisation", i.e., a situation where all goods and some factors are internationally mobile, decreases the real factor price differentials step by step. This distinguishes the present paper from Falvey (1999) who did not analyze international factor mobility, which is considered now as a major element of globalisation, and Neary (1985) who analyzed only situations with fully integrated goods markets. The symmetry of the results for the increase the mobility of factors and goods, respectively, is consistent with the view exposed in Neary (1993) that trade in factors and goods can be treated symmetrically for many purposes.

[21] In deriving (38), we have used the equality

$$G_{VN}(\overline{M}_N)^{-1}G_{NV}dV = A'_V(\overline{M}_N)^{-1}A_V dV \tag{*}$$

The reasoning is as follows. First, one can equivalently use G_{NV} and A_V on both sides of (*) because it follows from the argument made in fn. 20 that the difference $(\overline{M}_N)^{-1}e_N G'_V dV$ is a zero vector (set $\gamma = G'_V dV$). Given this, it does not matter whether we use G_{VN} or A'_V in (*) because by (32) and (34) the difference is $G_V dP$ which is again a zero vector.

Appendix

Since M_N^{-1} is symmetric, by the spectral theorem there exists an orthogonal matrix R such that $R^{-1}M_N^{-1}R = D$ where D is a diagonal matrix whose elements $(d_1, \ldots, d_N)$ are the eigenvalues of M_N^{-1}. As R is orthogonal, $R' = R^{-1}$, and we can write $M_N^{-1} = RDR'$. We then have

$$(\overline{M}_N)^{-1} = RFR'$$

with $F \equiv D - Dz(z'Dz)^{-1}z'D$ and $z \equiv R'e_N$. We go on to show that F is negative semidefinite which implies that $(\overline{M}_N)^{-1}$ is negative semidefinite because every quadratic form $x'(\overline{M}_N)^{-1}x$ can be written as $y'Fy$, where $y \equiv R'x$. Routine calculations show that F is symmetric with elements

$$f_{ii} = d_i\left(1 - \frac{d_i z_i^2}{\sum_{j=1}^{N} d_j z_j^2}\right) \qquad \text{and} \qquad f_{ik} = -\frac{d_i d_k z_i z_k}{\sum_{j=1}^{N} d_j z_j^2}$$

Let F_K denote a principal minor of order K of F, and $k \in K$ the numbers of the rows and columns included in K. Then one can show that

$$F_K = \left(1 - \frac{\sum_{k\in K} d_k z_k^2}{\sum_{j=1}^{N} d_j z_j^2}\right) \prod_{k\in K} d_k$$

With all eigenvalues of M_N^{-1} being negative, we have $(-1)^i F_i > 0 \ \forall i \neq N$, and $F_N = 0$. This establishes that F is negative semidefinite.

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