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PRODUCT MARKET INTEGRATION, COMPARATIVE ADVANTAGES AND LABOUR MARKET PERFORMANCE

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Product Market Integration, Comparative Advantages and Labour Market Performance*

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Abstract

In this paper, we set up a two-country general equilibrium model where trade unions have wage bargaining power. We show that a decrease in trade distortions inducing further product market integration gives rise to specialization gains as well as a labour market reform effect. The implications of the specialization gains are similar to an increase in labour productivity, whereas the labour market reform effect is similar to an increase in the degree of competition in the labour market. Wages, employment and welfare increase as a result of further product market integration. It is interesting to note that the labour market reform effect of product market integration is achieved despite an increase in the wage level.

JEL Classification: F15, J30, J50.

Keywords: Trade frictions, wage formation, employment, welfare gains.

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1 Introduction

The globalization process has been most visible in financial market interactions and the growth in trade flows (see e.g. IMF (2002)). In contrast, labour mobility has not been significantly affected so far, and therefore labour market implications have to arise as a response to changes in capital and goods markets. From a European perspective, the indirect labour market consequences are potentially very important given that European product market integration is proceeding fast, and labour markets are often asserted to suffer from structural problems. A view often raised in the debate is that the implications of international integration are similar to a labour market reform eroding the bargaining power of trade unions (see e.g. Rodrik (1997) and Andersen, Haldrup and Sørensen (2001)). Although this may benefit society as a whole, the income distribution may change to the disadvantage of trade union members. The labour market reform effect of product market integration will be accompanied by specialization gains as a result of further exploitation of comparative advantages (see e.g. Dornbusch, Fischer and Samuelson, 1977). These specialization gains are going to increase labour demand and counteract any downward pressure on wages of the labour market reform effect.

In this paper, we set up a two-country general equilibrium model where product market integration gives rise to a labour market reform effect as well as an effect on international specialization of production. Despite the presence of the labour market reform effect, it turns out that product market integration gives rise to an unambiguous increase in real wages and employment. The reason is that lower product market frictions make it possible to allocate production better according to comparative advantages, and this is like a general productivity increase making it possible to improve both real wages and employment. This shows that there are gains from product market integration, also in economies with imperfectly competitive labour markets. This result may explain why trade unions in most European countries have been in favour of further European integration even though it is uncertain how the market power of trade unions may be affected in the process.

Most of the theoretical literature on the labour market consequences of product market integration has focused on the implications of international integration for the degree of competition in product markets and how this affects the market power that can be exerted in labour markets. Specifically, it has been analysed how lower trade frictions affect the market power in

models of reciprocal dumping (see e.g. Huizinga (1993), Sørensen (1993), Naylor (1998), Andersen and Sørensen (2000)).[1] As is well known, the reciprocal dumping model can explain two-way trade in identical commodities, and the basic reason for trade is product market power causing prices to exceed marginal costs, which induces cross-country market entry. While these models yield a number of interesting insights they rely on one particular reason for trade (i.e. reciprocal dumping), which has been contested, and also strategic assumptions (i.e. Cournot competition), which can be called into question (see e.g. Krugman (1995)).[2] Moreover, these models tend to be partial equilibrium models in the sense that they focus on a specific sector, ignoring interdependencies among sectors, and ignoring changes in the range of goods produced.

In this paper we present a general equilibrium analysis of the labour market implications of product market integration leading to more specialization in production and an increase in international (intra-industrial) trade. Recent empirical evidence indicates not only a strong increase in intra-industrial trade (see e.g. Coppel and Durand (1999)), but also in specialization (see e.g. Midelfart-Knarvik et al. (2000)). To explain observed trade flows, it is necessary to take into account comparative advantages, trade frictions and the presence of non-traded commodities (see e.g. Davis and Weinstein (2001) and Yi (2003)). It has also been documented that exporting firms tend to have higher productivity than comparable non-exporting firms, and the causality runs from productivity to export, i.e. productive firms become exporters. Export is also associated with exit of less productive firms and reallocation of resources to more efficient firms (see e.g. Bernhard and Jensen (1999a, 1999b)). The model presented here is in accordance with these stylized facts.

The empirical findings reported above point out that intra-firm differences are important for accounting for the empirical evidence. This has inspired a large amount of work about intra-industry trade in the presence of firm heterogeneity (see e.g. Helpman, Melitz and Yeaple (2004), Eaton and Kortum (2002), Bernard, Eaton, Jensen and Kortum (2003) and Bernard, Jensen and

[1] Driffill and van der Ploeg (1993) present a model with an exogenously given specialized production structure, and show that wage formation is affected when tariffs are lowered because the responsiveness of prices to wages changes.

[2] Gürtzen (2002) presents a version of the model with Bertrand competition in commodities that are imperfect subsidies, i.e. specialization is implied by the preference structure and unaffected by further product market integration.

Schott (2003)). This paper is related in considering the role of firm heterogeneity for wage formation in economies with imperfectly competitive labour markets. Endogenous trade and specialization have important implications for the link between product and labour markets, and we consider how this affects wage formation, employment and welfare.

The rest of the paper is organized as follows: Section 2 develops a two-country general equilibrium model with trade frictions and differences in comparative advantages. Section 3 considers wage determination and the basic effects of product market integration, while section 4 analyses the general equilibrium effects of reductions in trade frictions. Section 5 decomposes the net effect of product market integration into a labour market reform effect and an effect arising as a result of further specialisation of production. Section 6 offers a few concluding remarks.

2 Product market integration

Consider the following stylized case: We have two representative (European) countries[3] trading with each other in various products subject to trade frictions. An ongoing integration process reduces frictions in goods trade. Neither real capital (suppressed) nor labour is mobile across countries. Product markets are competitive,[4] but labour is organized in trade unions setting a wage under a right to manage structure. The countries are assumed to be symmetric with respect to technology and the distribution of relative factor supplies (see below).

Households

Households demand a variety of differentiated goods, and they can acquire goods from either domestic or foreign producers. Each household supplies a specific type of labour matching the labour requirements of one particular production activity (see below). Moreover, households own firms and are

[3] The model considers trade between two countries with fairly similar factor endowment. It can be seen as a model of the substantial amount of trade between e.g. European countries.

[4] Note that the same mechanism determining the boundary between exports, imports and non-tradeables is present if firms are in a monopolistically competitive (Bertrand) position, see Andersen (2002).

entitled to profits. The utility of the representative household type $h \in [0,1]$ is assumed to be

$$U_h = c_h - dl_h^{\gamma}, \quad \gamma > 1. \tag{1}$$

This formulation captures the utility from consumption of the private consumption bundle c_h (see below), and the disutility of work l_h. Note that d normalizes the disutility of work to the utility of consumption. The budget constraint of the household reads

$$Qc_h = I_h + \Pi_h, \tag{2}$$

where Q is the consumer price index (see below), Π_h denotes nominal profits, and I_h nominal labour income.

The consumption bundle, c_h, is defined over commodities of different types, produced in different sectors, indexed by j,

$$c_h = [\int_0^1 c_{hj}^{\frac{\theta-1}{\theta}} dj]^{\frac{\theta}{\theta-1}}, \tag{3}$$

where θ (> 1) measures the elasticity of substitution between the different types of goods. The associated price index is given by

$$Q \equiv [\int_0^1 Q_j^{1-\theta} dj]^{\frac{1}{1-\theta}}. \tag{4}$$

The demand by household h of commodities of type j is given as

$$c_{hj} = [\frac{Q_j}{Q}]^{-\theta} c_h. \tag{5}$$

The consumption bundle of goods of type j is similarly defined over subtypes of products indexed by i, i.e.

$$c_{hj} = [\int_0^1 c_{hji}^{\frac{\theta-1}{\theta}} di]^{\frac{\theta}{\theta-1}}. \tag{6}$$

For simplicity the elasticity of substitution between these subtypes of goods is also assumed to be given by θ. The associated price index is

$$Q_j \equiv [\int_0^1 Q_{ji}^{1-\theta} di]^{\frac{1}{1-\theta}}, \tag{7}$$

and the demand by household h of commodity i, produced in sector j, is given as

$$c_{hji} = [\frac{Q_{ji}}{Q_j}]^{-\theta} c_{hj}. \tag{8}$$

Aggregate demands are found by aggregation of demand by individual households to read

$$c_j = [\frac{Q_j}{Q}]^{-\theta} c, \tag{9}$$

$$c_{ji} = [\frac{Q_{ji}}{Q_j}]^{-\theta} c_j, \tag{10}$$

where c is aggregate consumption.

Consumers can acquire commodities from either domestic or foreign producers of consumption goods. A given variety i in the goods category j is offered by domestic producers at a price P_{ji} in the domestic market and by foreign producers at a price P^*_{ji} in the foreign market. However, there are frictions involved in international trade (see e.g. Dornbusch, Fischer and Samuelson (1977)) that can be seen as non-tariff impediments to trade. These costs can also be interpreted as information or search costs concerning foreign markets, and they can include both fixed and proportional components. However, since the qualitative results of the paper hold in either case, we choose to work with the more simple case of proportional costs.

Let z_{ji} denote the gross costs of acquiring one unit from a foreign supplier. Hence, $z_{ji} \geq 1$ since acquisition of one unit of the commodity may absorb resources to overcome trade frictions ($z_{ji} = 1$ corresponds to frictionless international trade). It is assumed that the trade friction is a function of an indicator variable τ, i.e. $z_{ji} = z_{ji}(\tau)$, where z_{ji} is increasing in τ. The parameter τ will in the following be varied to capture product market integration arising from a reduction in trade frictions.

Domestic consumers choose a domestic supplier if

$$P_{ji} \leq P^*_{ji} z_{ji}, \tag{11}$$

while a foreign supplier is chosen if

$$P_{ji} > P^*_{ji} z_{ji}. \tag{12}$$

It follows that the consumer price $Q_{ji} = P_{ji}$ if the final good is acquired from a domestic producer, and $Q_{ji} = P^*_{ji} z_{ji}$ if it is acquired from a foreign producer.

Producers

Firms in sector j produce goods of type j by use of labour type j, subject to a linear production technology

$$y_{ji} = A_{ji} l_{ji}, \tag{13}$$

where A_{ji} is an exogenous productivity parameter for a firm producing good i in sector j. The productivity parameter allows for trade based on differences in comparative advantages (see below).

The relative productivity of domestic labour to foreign labour in producing commodity i in sector j is defined as

$$a_{ji} \equiv \frac{A_{ji}}{A^*_{ji}}. \tag{14}$$

The comparative advantage variable a_{ji} is symmetrically distributed with a density function[5] $g(a_{ji})$, where $a_{ji} \in [\lambda^{-1}, \lambda], \lambda > 1$.[6] This implies that $a_{ji} = 1$ for $i = 1/2$, that is, for half the goods produced in sector j, the domestic economy has a comparative advantage relative to the foreign country and vice versa. Note that it is an implication that the average skill levels are the same in the two countries. The distribution of comparative advantages can reflect historic specialization in various product varieties (see e.g. Grossman and Helpman (1995)).

The production structure captures the fact that various producers in a certain sector convert similar kinds of input into different final consumption goods. There is perfect competition and, hence, the price is

$$P_{ji} = A^{-1}_{ji} W_j. \tag{15}$$

where W_j is the wage rate in the domestic country in sector j.

Using this price formula, it is possible to determine which final goods are produced domestically, and which are imported. To this end consider first

[5] It is assumed that $g(a_{ji}) < g*$, i.e. the distribution of comparative advantage does not have too much mass at a single point.

[6] Assume that A_{ji} is uniformly distributed over the interval $[1-x, 1+x]$ and similarly for A^*_{ji}. Hence $\frac{A_{ji}}{A^*_{ji}}$ is distributed over the interval $\left[\frac{1-x}{1+x}, \frac{1+x}{1-x}\right]$, with a density function with the property that $g(\frac{1}{y}) = g(y)$.

the condition ensuring that domestic consumers choose a domestic supplier (i.e. (11)), which can be written as

$$A_{ji}^{-1}W_j \leq z_{ji}A_{ji}^{*-1}W_j^*, \tag{16}$$

or

$$w_j \leq z_{ji}a_{ji}, \tag{17}$$

where $w_j = \frac{W_j}{W_j^*}$ is the relative wage.

Similarly, foreign consumers choose domestic suppliers if

$$w_j \leq z_{ji}^{-1}a_{ji}. \tag{18}$$

We thus have that a specific commodity i in product group j is exported provided $i \in E_j$, where

$$E_j \equiv \left\{ i \mid w_j < z_{ji}^{-1}a_{ji} \right\} \tag{19}$$

is a non-traded good provided $i \in NT_j$, where

$$NT_j \equiv \left\{ i \mid z_{ji}a_{ji} \geq w_j \geq z_{ji}^{-1}a_{ji} \right\}, \tag{20}$$

and, finally, that it is imported if $i \in I_j$,where

$$I_j \equiv \left\{ i \mid w_j > z_{ji}a_{ji} \right\}. \tag{21}$$

Whether given commodities are exported, imported or non-traded is determined endogenously depending on relative wages, comparative advantages and trade frictions. Trade can be interpreted as intra-industrial trade since there is trade within industry j with some product types being exported and other types being imported. It is an implication that trade is related to specialization as export goods are only produced in the home country and vice versa for import goods. The non-traded sector represents varieties being produced in both countries. If lower trade frictions lead to more trade (see below) and a shrinking non-tradeable sector, it follows that this is accompanied by more specialization. Observe that two-way trade of identical commodities never occurs (ji), but export and import of commodities of a given category do (j).

For later reference, observe that consumer prices are given as

$$Q_{ji} = \begin{cases} P_{ji} = A_{ji}^{-1}W_j \;\; if \; i \in E_j \; U \; NT_j \\ z_{ji}P_{ji}^* = z_{ji}A_{ji}^{*-1}W_j^* \;\; if \; i \in I_j \end{cases}, \tag{22}$$

and therefore

$$Q_j = \left[W_j^{1-\theta} \int_{i \in E_j \cup NT_j} A_{ji}^{\theta-1} di + W_j^{*1-\theta} \left[\int_{i \in I_j} z_{ji}^{1-\theta} A_{ji}^{*\theta-1} di \right] \right]^{\frac{1}{1-\theta}}. \tag{23}$$

Since all sectors are symmetric this also defines the aggregate price level ($Q_j = Q$).

Labour demand

The demand for labour of variety j can now be determined. Although not directly in competition over jobs with foreign workers, domestic workers are affected by international trade since the wage rate affects the competitiveness of domestic firms and hence which goods are traded.

From the perspective of the workers, the home market is thus

$$H_j = E_j \ \cup \ NT_j = \{ i \mid w_j \leq z_{ji} a_{ji} \}, \tag{24}$$

and the export market is

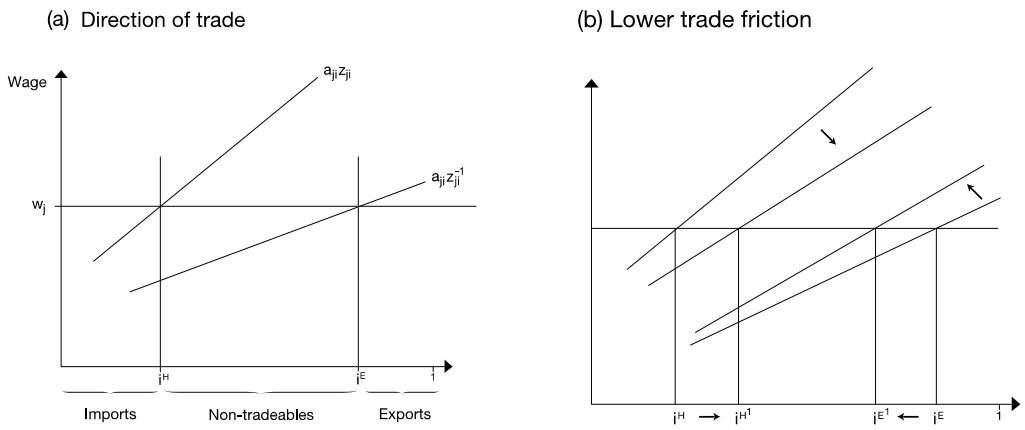
$$E_j = \left\{ i \mid w_j < z_{ji}^{-1} a_{ji} \right\}. \tag{25}$$

We make the monotonicity assumption that both a_{ji} and z_{ji} are monotonously increasing in i, where $\varepsilon_{a_{ji},i} > \varepsilon_{z_{ji},i}$.[7] It then follows that there exists a critical value of i- in the following denoted i^H- with the property that all $i \geq i^H$ belong to H_j. Similarly, there is a critical value of i - in the following denoted i^E- with the property that all $i \geq i^E$ belong to E_j. Note[8] that $i^E \geq i^H$. It also follows that $i^E = i^E(w_j, \tau)$, and $i^H = i^H(w_j, \tau)$, where $\frac{\partial i^E}{\partial w_j} > 0$, and $\frac{\partial i^H}{\partial w_j} > 0$, i.e. an increase in the relative wage of domestic labour increases the range of goods being imported and reduces the range of goods being exported. A reduction of trade frictions leads to an increase in i^H and a decrease in i^E, i.e. more imports and exports, and the non-tradeables sector shrinks. Figure 1 illustrates the endogenous determination of which goods are traded and the direction of trade as well as how this is affected by a reduction of trade frictions.

[7] In the following $\varepsilon_{x,y}$ denotes the elasticity of x wrt y.

[8] Since $z_{ji} \geq 1$, it follows that $i \in E_j \Rightarrow i \in H_j$, while $i \in H_j \not\Rightarrow i \in E_j$.

Figure 1:



Using the demand and production functions (i.e. (9), (10) and (13)), the total labour demand in sector j can be written

$$L_j = \int_{i^H}^{1} \frac{1}{A_{ji}} [\frac{Q_{ji}}{Q_j}]^{-\theta} [\frac{Q_j}{Q}]^{-\theta} c di + \int_{i^E}^{1} \frac{z_{ji}}{A_{ji}} [\frac{Q^*_{ji}}{Q^*_j}]^{-\theta} [\frac{Q^*_j}{Q^*}]^{-\theta} c^* di, \tag{26}$$

The first part on the RHS gives the labour demand generated by supplying goods to the domestic market, and the second part is the labour demand generated by supplying to the foreign market. Inserting the relevant consumer prices, we find that

$$L_j = \phi^H(\frac{W_j}{W^*_j}, \tau)[\frac{W_j}{Q}]^{-\theta} c + \phi^E(\frac{W_j}{W^*_j}, \tau)[\frac{W_j}{Q^*}]^{-\theta} c^* \tag{27}$$

where

$$\phi^H(\frac{W_j}{W^*_j}, \tau) \equiv \int_{i^H}^{1} A_{ji}^{\theta-1} di, \tag{28}$$

$$\phi^E(\frac{W_j}{W^*_j}, \tau) \equiv \int_{i^E}^{1} z_{ji}^{1-\theta} A_{ji}^{\theta-1} di. \tag{29}$$

Note that ϕ^H is positively related to the share of production going to the home market, and ϕ^E to the share of production going to the foreign market.

Equilibrium conditions

Assuming that there are no profits in equilibrium, it follows from the budget constraint of the households that

$$c = \int_0^1 W_j L_j dj. \tag{30}$$

It is an implication that trade is balanced. Moreover, employment is demand determined (see (27)) given the right to manage structure underlying wage formation (see below). Finally, and total demand for a given product variety equals supply, i.e.

$$\begin{aligned} c_{ji} + c^*_{ji} &= y_{ji} \; for \; i \in E_j, & (31)\\ c_{ji} &= y_{ji} \; for \; i \in NT_j, & (32)\\ c_{ji} + c^*_{ji} &= y^*_{ji} \; for \; i \in I_j. & (33) \end{aligned}$$

Similar relations hold for the foreign country.

3 Wage formation

We assume that workers supplying labour for production in sector j are organized in a trade union that sets the wage under a right to manage structure, and take all aggregate variables as given. The trade union is assumed to be utilitarian, and, since the disutility of work is increasing in employment, trade union members share the employment. That is the wage is chosen so as to solve

$$Max \; U_j = \frac{W_j}{Q} L_j - d L_j^{\gamma}, \tag{34}$$

where the number of trade union members has been normalized to one. The wage rate turns out to be

$$\frac{W_j}{Q} = \frac{\varepsilon_{L_j,W_j}}{1+\varepsilon_{L_j,W_j}} d\gamma L_j^{\gamma-1}. \tag{35}$$

Equation (35) gives the wage curve as depending on the mark-up parameter, determined in the usual way via the elasticity of labour demand ε_{L_j,W_j}, the parameter d determining the level of disutility of work, and the amount

of employment. Note that the wage is increasing in employment with an elasticity of $\gamma - 1 > 0$.

Labour demand elasticity

The wage curve (35) links product and labour markets via the mark-up determined by the labour demand elasticity ε_{L_j,W_j} and, therefore, the trade-off between wages and employment faced by workers. The latter affects the effective market power of trade unions, and since it depends on product market structures it is affected by product market integration.

The labour demand elasticity is found to be:

$$\varepsilon_{L_j,W_j} = -\theta + v\varepsilon_{\phi^H,W_j} + (1-v)\varepsilon_{\phi^E,W_j}, \tag{36}$$

where v denotes the share of production going to the home market

$$v \equiv \frac{\phi^H(\frac{W_j}{W_j^*},\tau)[\frac{W_j}{Q}]^{-\theta}y}{\phi^H(\frac{W_j}{W_j^*},\tau)[\frac{W_j}{Q}]^{-\theta}y + \phi^E(\frac{W_j}{W_j^*},\tau)[\frac{W_j}{Q^*}]^{-\theta}y^*}. \tag{37}$$

One important fact concerning the demand elasticity for labour is that its numerical value exceeds the underlying elasticity of consumer demand, i.e. (see Appendix I)

$$\varepsilon_{L_j,W_j} < -\theta, \tag{38}$$

for $v < 1$, i.e. when there is trade. The intuition is that there are two dimensions of substitution, i.e. between different commodities and between domestic and foreign suppliers. The former is determined by consumer preferences and is given by the parameter θ, which is assumed constant. The latter effect arises via reallocation of production between domestic and foreign firms. This can also be termed a relocation of production and thus employment effect due to tighter product market integration. In other words, it implies that production (employment) becomes more "mobile" across national borders even though there is no factor mobility. Labour demand elasticity is thus higher in an open than in a closed economy where it is only determined by the degree of substitution in consumption. How further integration affects the labour demand elasticity is, however, ambiguous, i.e.

$$\frac{\partial\varepsilon_{L_j,W_j}}{\partial\tau} = \frac{\partial\left[v\varepsilon_{\phi^H,W_j} + (1-v)\varepsilon_{\phi^E,W_j}\right]}{\partial\tau} \gtreqless 0. \tag{39}$$

Therefore, in general it is not possible to conclude whether the unions' effective bargaining power decreases or increases as a result of an increase in τ. As shown below, it is still possible to make inferences on how real wages and employment are affected in general equilibrium.

4 General equilibrium

The global or two-country general equilibrium can fairly easily be worked out exploiting the symmetry conditions in the model.

Trade

First consider trade. In the symmetric equilibrium, the home markets in the two countries are of equal size, i.e.

$$i_H = 1 - i_E. \tag{40}$$

Lower trade frictions imply that i^H increases and i^E decreases. From (40), it follows that there is an increase in the range of exported commodities, which is similar to the increase in the range of imported commodities. That is, the non-tradeable sector decreases both because more goods are exported and because more goods are imported. Consequently, production becomes more specialized reflecting that the allocation of production across countries to a larger extent reflects comparative advantages. Trade is thus driven by productivity (comparative advantages), and production becomes more efficiently allocated, the lower the trade frictions are.

Productivity

Aggregate labour productivity for the types of activities in operation domestically can be written

$$\overline{A} \equiv \frac{\int_{i^H}^1 A_{ji} di}{\int_{i^H}^1 di}, \tag{41}$$

from which it follows that

$$\frac{\partial \overline{A}}{\partial i^H} = \left[\overline{A} - A_{ji^H}\right] \int_{i^H}^1 di > 0. \tag{42}$$

A lower trade friction (τ) implies that i^H increases and, therefore, that average productivity goes up.[9] The intuition is that further product market integration implies that less efficient domestic production is squeezed out by more productive foreign production, i.e. production becomes more efficiently allocated across countries according to comparative advantage (see also e.g. Melitz (2003)). As a result, aggregate labour productivity goes up, which means an outward shift in the possibility set of real wages and employment available to the economy.

Wages and employment

Turning to equilibrium real wages and employment, we find by imposing the conditions for a symmetric equilibrium on (27) that the real wage is determined from the relation

$$1 = \left[\phi^H(1,\tau) + \phi^E(1,\tau)\right] [\frac{W}{Q}]^{1-\theta}. \tag{43}$$

The definitions of ϕ^H and ϕ^E (see (28) and (29)) and (40) imply that

$$\frac{\partial \phi^H(1,\tau)}{\partial \tau} + \frac{\partial \phi^E(1,\tau)}{\partial \tau} > 0. \tag{44}$$

It follows that the real wage is decreasing in the level of trade frictions, by use of (44) and (43), i.e.

$$\frac{\partial \left(\frac{W}{Q}\right)}{\partial \tau} < 0. \tag{45}$$

Lower trade frictions lead to higher real wages for two reasons, namely the direct effect arising from lower prices of all imported commodities, and the indirect effect arising from better match of production according to comparative advantages. The latter is like a general productivity increase, cf. above. It is noteworthy that demand elasticity ε_{L_j,W_j} does not enter this expression.

It follows straightforwardly (by using (27), (44) and (45)) that employment is also decreasing in the level of trade frictions, i.e.

$$\frac{\partial L}{\partial \tau} < 0. \tag{46}$$

[9] Note that since production is distributed according to comparative advantage, and the relative productivity of domestic firms is increasing in index i, it follows that $\overline{A} > A_{ji^H}$.

Accordingly, a reduction of trade frictions leads to an increase in both real consumption wages and employment in equilibrium.

Welfare

Finally, consider the welfare effects. The utility of households can in symmetric equilibrium be written

$$U = \frac{W}{Q}L - dL^{\gamma}. \tag{47}$$

By using (35), (45) and (46), it follows that

$$\frac{\partial U}{\partial \tau} = \frac{\partial \frac{W}{Q}}{\partial \tau}L + \left[\frac{\varepsilon_{L_j,W_j}}{1+\varepsilon_{L_j,W_j}} - 1\right] d\gamma L^{\gamma-1}\frac{\partial L}{\partial \tau} > 0. \tag{48}$$

A decrease in the trade friction (τ) gives rise to an unambiguous improvement in welfare, the reason being that a gain arises from higher real wages as well as from higher employment. There are several reasons for the increase in welfare. The reduction in trade costs saves resources, which in turn leads to a decrease in consumer prices. Furthermore, since more goods are traded, there is increasing specialization in goods production, which also tends to give rise to lower consumer prices. Finally, observe that the higher the market power of unions (the less sensitive employment is to wages), the lower employment is and, therefore, the larger the gains from improvements in employment.

5 Labour market reform versus specialization gains

In the present framework wage formation is distorted due to the market power of unions (imperfectly competitive labour markets), and this obviously causes an efficiency loss. However, although product market integration does not affect the formal position of the union (it remains a monopoly union operating under a right to manage structure), its possibilities for exerting market power changes. The reason is that the scope for relocation of product and specialization induced by lower trade frictions changes the trade-off between wages and employment, cf. above. The change in the "effective" market power of unions is the reason the effect of product market integration has been termed an indirect labour market reform, cf. introduction.

However, based on the results presented above, it is not possible to assert the importance of this labour market reform effect. The reason being that there is also a specialization effect (and subsequent standard gains) due to lower trade friction, and this effect would be present also in a competitive labour market. To disentangle the labour market reform effect from the specialization effects so as to ascertain the relative strength of the two, we are going to compare the outcome in the case of a competitive labour market (index C below) with the imperfectly competitive case considered so far (index IC below). By definition, the former case has no market distortions and it, therefore, isolates the specialization effect implying that the difference between the competitive and imperfectly competitive case reflects the importance of market power in the labour market.

The demand side of the economy is the same in the competitive case as in our main case with imperfect competition. However, in the competitive case, the wage curve (the inverse supply function of labour) reads

$$\frac{W_j}{Q} = d\gamma L_j^{\gamma-1}, \tag{49}$$

which should be compared to (35) in the case of imperfect competition on the labour market, i.e. the difference is captured by the wage mark-up determined by the elasticity of labour demand.

It is easily seen that the real wage in general equilibrium becomes the same in the competitive version as in the imperfect competition version of the model (determined by (43)). Hence, the only difference is the level of employment which, in the competitive version, becomes:

$$L^C = \left(\frac{W}{Qd\gamma}\right)^{\frac{1}{\gamma-1}}. \tag{50}$$

In the imperfect competition version it becomes

$$L^{IC} = \eta L^C, \tag{51}$$

where

$$\eta = \left(\frac{1+\varepsilon}{\varepsilon}\right)^{\frac{1}{\gamma-1}} < 1. \tag{52}$$

η can be termed the employment efficiency factor since it measures the reduction in employment caused by market power in the labour market and

thus the efficiency consequences of imperfect competition measured in terms of employment. An increase in η is equivalent to a decrease in the labour market distortion. We see that the labour market distortion is closely related to the labour demand elasticity. Hence, if the labour demand elasticity increases, the labour market distortion decreases and vice versa.

Welfare can be written

$$U^i = \frac{W}{Q} L^i - d\left(L^i\right)^\gamma, \qquad i = C, IC, \tag{53}$$

and by use of (50) and (51) welfare in the two cases can be written

$$U^{IC} = \xi U^C, \tag{54}$$

where

$$\xi = \frac{\gamma^{\frac{1}{1-\gamma}} e - \gamma^{\frac{\gamma}{1-\gamma}} e^\gamma}{\gamma^{\frac{1}{1-\gamma}} - \gamma^{\frac{\gamma}{1-\gamma}}} < 1 \tag{55}$$

is a measure of the utility consequences of imperfect competition. The utility factor ξ measures by how much utility is lowered due to market power in the labour market. Obviously, this utility loss is related to the efficiency loss measured in terms of employment since

$$\frac{\partial \xi}{\partial \eta} = \frac{\gamma^{\frac{1}{1-\gamma}} - \gamma^{\frac{1}{1-\gamma}} e^{\gamma-1}}{\gamma^{\frac{1}{1-\gamma}} - \gamma^{\frac{\gamma}{1-\gamma}}} > 0. \tag{56}$$

Hence, the less inefficiency in the labour market (i.e. the higher η), the smaller the welfare loss in the imperfectly competitive case compared to the competitive case.

To simplify, we will in the following assume that the cost of international trade is the same for all goods (i.e. $z_{ji} = z \ \forall \ i, j$). Moreover, we assume a uniform density for absolute productivity, i.e.

$$\begin{aligned} A_{ji} &= \frac{1}{\lambda} + (\lambda - \frac{1}{\lambda})i, \qquad \forall i \in [0,1], \\ A^*_{ji} &= \lambda - (\lambda - \frac{1}{\lambda})i, \qquad \forall i \in [0,1], \end{aligned}$$

which implies that relative productivity is given as

$$a_{ji} = \frac{\frac{1}{\lambda} + (\lambda - \frac{1}{\lambda})i}{\lambda - (\lambda - \frac{1}{\lambda})i} = \frac{1 + (\lambda^2 - 1)i}{\lambda^2 - (\lambda^2 - 1)i}.$$

Hence, relative productivity or comparative advantage varies between $\frac{1}{\lambda^2}$ for $i = 0$ and λ^2 for $i = 1$. It can be shown (see Appendix II) that a uniform distribution is sufficient to ensure that labour demand becomes more elastic to the wage rate when product markets become more integrated, i.e.

$$\frac{\partial \varepsilon_{L_j, W_j}}{\partial \tau} < 0, \tag{57}$$

when evaluating the elasticity in a symmetric equilibrium. It follows that a decrease in τ gives rise to an increase in the efficiency of the imperfectly competitive labour market, i.e. there is an increase in η and ξ. In other words, under these circumstances, there is a labour market reform effect of product market integration. It is important to note that the labour market reform effect is achieved despite an increase in the equilibrium wage rate. This is in contrast to most "real" labour market reforms, which usually seek to diminish wages or other labour costs that are "too high" due to labour market distortions

If there is an increase in the labour demand elasticity, there is a labour market reform effect, but the importance of the labour market reform effect relative to the specialization gains is an open question. To gain further insights into the relative importance of the labour market reform effect, we turn to some numerical results.[10] However, we want to emphasize that, since our model is highly stylized, these simulations are only suggestive.

[10] The numerical illustrations are based on the following parameter values: $d = 1, \gamma = 3, \theta = 2$ and $\lambda = 2$. Note that the results are fairly robust to variations in the parameter values. However, the discrete jump arising in the employment efficiency and utility factor, when moving from autarky to trade, is very sensitive to the elasticity γ.

Figure 2: Numerical illustrations

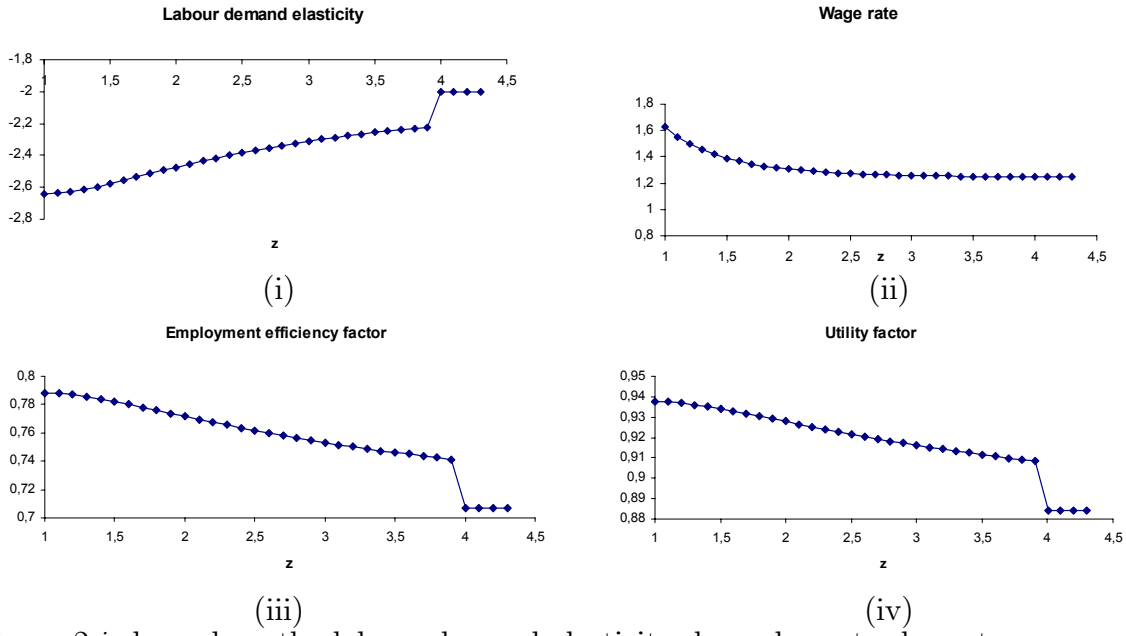


Figure 2.*i* shows how the labour demand elasticity depends on trade costs. We see that there is a jump in the labour demand elasticity when trade costs are reduced from a high level with no international trade (i.e. $z > 4$) to a level where international trade begins (i.e. $z < 4$). When the process of international integration proceeds and lower trade costs, it is seen that labour demand becomes more and more sensitive to the wage rate (the labour market reform effect of product market integration).

This change in the labour demand elasticity has a number of effects. Figure 2.*ii* illustrates how trade costs affect employment in the imperfect competition case relative to employment in the competitive case (i.e. e in (52)). A decrease in trade costs gives rise to a discrete increase in relative employment when trade is induced, and further reductions in trade costs makes employment approach the competitive level more, but without reaching this level in the case of free trade, i.e. free trade does not eliminate market power. Interestingly figure 2.*iii* shows that the wage rate is increasing in the trade cost, i.e. the specialization effect, always dominates the labour market reform effect.

Finally, in figure 2.*iv*, we illustrate how the utility of a representative household develops relative to the utility of a representative household in the competitive economy (i.e. ξ in (55)). Similar to the employment results,

we see a discrete change when trade is induced, and then an increase in the utlity factor as trade costs are lowered.

6 Concluding remarks

We have analysed the effects of product market integration (i.e. a reduction in international trade frictions) in a setting with trade driven by comparative advantages and with imperfectly competitive (unionized) labour markets. In the following, we summarize our main results.

Product market integration gives rise to further specialization in goods production. Hence, more goods are traded, which in turn means more efficient exploitation of comparative advantages. We have also shown that this is very similar to a general increase in labour productivity.

Product market integration gives rise to an increase in the wage level as well as an increase in employment. This implies that there is an increase in the welfare of a representative consumer.

In our model, a decrease in trade costs gives rise to specialization gains as well as a labour market reform effect. The labour market reform effect is a result of an increase in the labour demand elasticity, which is similar to a labour market reform increasing the degree of competition in the labour market. The labour market reform effect of further product market integration seems to be most important when trade costs decrease from a high level.

The intention of most "real" labour market reforms is to decrease wages or other labour cost that are too high due to labour market distortions. It is interesting to note that product market integration gives rise to a labour market reform effect despite an increase in the wage level.

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APPENDIX I

From (28) and (29) we have

$$\phi^H(\frac{W_j}{W_j^*},\tau) = \int_{i^H}^1 A_{ji}^{\theta-1}di, \tag{58}$$

$$\phi^E(\frac{W_j}{W_j^*},\tau) = \int_{i^E}^1 z_{ji}^{1-\theta}A_{ji}^{\theta-1}di. \tag{59}$$

First, we notice that $\phi^H(\frac{W_j}{W_j^*},\tau) \geq \phi^E(\frac{W_j}{W_j^*},\tau)$. This follows by observing that $z_{ji}^{-\theta} \leq 1$ and $i^H \leq i^E$.

Next, we shall prove that $v\varepsilon_{\phi^H,w_j} + (1-v)\varepsilon_{\phi^E,w_j} < 0$ for $v < 1$. Note first that

$$w_j = a_{ji^H}z_{ji^H}, \tag{60}$$

$$w_j = a_{ji^E}z_{ji^E}^{-1}. \tag{61}$$

defines $i^H$and i^E as implicit functions of w_j, where $\frac{\partial i^H}{\partial w_j} > 0, \frac{\partial i^E}{\partial w_j} > 0$, since

$$\frac{\partial\left(a_{ji^H}z_{ji^H}\right)}{\partial i}\frac{i}{a_{ji^H}z_{ji^H}} = \varepsilon_{a_{ji},i} + \varepsilon_{z_{ji},i} > 0,$$

$$\frac{\partial\left(a_{ji^E}z_{ji^E}^{-1}\right)}{\partial i}\frac{i}{a_{ji^E}z_{ji^E}^{-1}} = \varepsilon_{a_{ji},i} - \varepsilon_{z_{ji},i} > 0,$$

where the signs follow from the monotonicity assumptions made on a_{ji} and z_{ji}.

It now follows straightforwardly that

$$\varepsilon_{\phi^H,w_j} = -A_{ji^H}^{\theta-1}\frac{\partial i^H}{\partial w_j}\frac{w_j}{\phi^H} < 0, \tag{62}$$

$$\varepsilon_{\phi^E,w_j} = -A_{ji^E}^{\theta-1}z_{ji^E}^{1-\theta}\frac{\partial i^E}{\partial w_j}\frac{w_j}{\phi^E} < 0. \tag{63}$$

For $0 \leq v < 1$, it follows that $v\varepsilon_{\phi^H,w_j} + (1-v)\varepsilon_{\phi^E,w_j} < 0$. Note that for $v = 1$, we have $i^H = 0$ and $\varepsilon_{\phi^H,w_j} = 0$.

APPENDIX II

In the following, we prove that, if the cost of international trade is the same for all goods (i.e. $z_{ji} = z \; \forall \; i, j$), and if there is a uniform density for absolute productivity, it follows that in the symmetric global general equilibrium:

$$\frac{\partial \varepsilon_{L_j,W_j}}{\partial z} < 0.$$

To see this we have from (36) that the labour demand elasticity is

$$\varepsilon_{L_j,W_j} = -\theta + v\varepsilon_{\phi^H,W_j} + (1-v)\varepsilon_{\phi^E,W_j}, \tag{64}$$

where v denotes the share of production going to the home market

$$v \equiv \frac{\phi^H(\frac{W_j}{W_j^*},\tau)[\frac{W_j}{Q}]^{-\theta}y}{\phi^H(\frac{W_j}{W_j^*},\tau)[\frac{W_j}{Q}]^{-\theta}y + \phi^E(\frac{W_j}{W_j^*},\tau)[\frac{W_j}{Q^*}]^{-\theta}y^*}. \tag{65}$$

In the symmetric equilibrium where $y = y^*$, it follows that

$$v \equiv \frac{\phi^H(1,\tau)}{\phi^H(1,\tau) + \phi^E(1,\tau)},$$

and

$$\begin{aligned} \phi^H(\frac{W_j}{W_j^*},\tau) &\equiv \int_{i^H}^1 A_{ji}^{\theta-1} di, \\ \phi^E(\frac{W_j}{W_j^*},\tau) &\equiv \int_{i^E}^1 z_{ji}^{1-\theta} A_{ji}^{\theta-1} di. \end{aligned}$$

Note that $\frac{\partial i^H}{\partial \tau} < 0, \frac{\partial i^E}{\partial \tau} > 0$ and therefore $\frac{\partial \phi^H}{\partial \tau} > 0, \frac{\partial \phi^E}{\partial \tau} < 0$. It now follows that v is increasing in the trade friction τ, i.e.

$$\frac{\partial \nu}{\partial \tau} = \frac{\frac{\partial \phi^H}{\partial \tau}\phi^E - \frac{\partial \phi^E}{\partial \tau}\left(\phi^H + \phi^E\right)}{\left[\phi^H + \phi^E\right]^2} > 0.$$

The critical values of the i-indexes i^H and i^E are defined from

$$\begin{aligned} w_j &= a_{ji^H} z, \\ w_j &= a_{ji^E} z^{-1}, \end{aligned}$$

and therefore

$$\begin{aligned}
\frac{\partial i^H}{\partial w}\frac{w}{i^H} &= \left[\frac{\partial a_{ji^H}}{\partial i^H}\frac{i^H}{w}\right]^{-1}, \\
\frac{\partial i^E}{\partial w}\frac{w_j}{i^E} &= \left[\frac{\partial a_{ji^E}}{\partial i^E}\frac{i^E}{a_{ji^E}}\right]^{-1}.
\end{aligned}$$

Note that $\varepsilon_{i^H,w}$ and $\varepsilon_{i^E,w}$ are independent of z.

From Appendix I we have

$$\begin{aligned}
\varepsilon_{\phi^H,W_j} &= -\varepsilon_{i^H,w}\frac{A_{ji^H}^{\theta-1}i^H}{\phi^H}, \\
\varepsilon_{\phi^E,W_j} &= -\varepsilon_{i^E,w}\frac{z^{1-\theta}A_{ji^E}^{\theta-1}i^E}{\phi^E},
\end{aligned}$$

which inserted in (65) yields:

$$\begin{aligned}
v\varepsilon_{\phi^H,W_j} + (1-v)\varepsilon_{\phi^E,W_j} &= -\frac{\phi^H}{\phi^H+\phi^E}\left[\varepsilon_{i^H,w}\frac{A_{ji^H}^{\theta-1}i^H}{\phi^H}\right] - \frac{\phi^E}{\phi^H+\phi^E}\left[\varepsilon_{i^E,w}\frac{z^{1-\theta}A_{ji^E}^{\theta-1}i^E}{\phi^E}\right] \\
&= \frac{-1}{\phi^H+\phi^E}\left[\varepsilon_{i^H,w}A_{ji^H}^{\theta-1}i^H + \varepsilon_{i^E,w}z^{1-\theta}A_{ji^E}^{\theta-1}i^E\right] \\
&= -\frac{z^{1-\theta}A_{ji^E}^{\theta-1}}{\phi^H+\phi^E}\left[\varepsilon_{i^H,w}i^H + \varepsilon_{i^E,w}i^E\right] < 0,
\end{aligned}$$

where it has been used that in symmetric equlibrium $A_{ji^H}^{\theta-1} = z^{1-\theta}A_{ji^E}^{\theta-1}$. This follows from observing that in symmetric equilibrium, the absolute level of productivity at which domestic firms start to export (and foreign markets to import) must equal the absolute level of productivity at which foreign firms start to export (and domestic markets to import), i.e. $A_{ji^E} = A_{ji^{E*}}$ and $A_{ji^H} = A_{ji^{H*}}$. Next using the definition $a_{ji^E} = \frac{A_{ji^E}}{A_{ji^{H*}}} = z$, the above stated condition follows.

Hence

$$\frac{\partial\left[v\varepsilon_{\phi^H,W_j} + (1-v)\varepsilon_{\phi^E,W_j}\right]}{\partial z} = -\frac{\partial\Gamma}{\partial z}\left[\varepsilon_{i^H,w}i^H + \varepsilon_{i^E,w}i^E\right] - \Gamma\frac{\partial\left[\varepsilon_{i^H,w}i^H + \varepsilon_{i^E,w}i^E\right]}{\partial z},$$

where

$$\Gamma \equiv \frac{z^{1-\theta} A_{ji^E}^{\theta-1}}{\phi^H + \phi^E} = \frac{A_{ji^E}^{\theta-1}}{z^{\theta-1} \int_{i^H}^1 A_{ji}^{\theta-1} di + \int_{i^E}^1 A_{ji}^{\theta-1} di},$$

and where it has been used that

$$\phi^H + \phi^E = \int_{i^H}^1 A_{ji}^{\theta-1} di + z^{1-\theta} \int_{i^E}^1 A_{ji}^{\theta-1} di.$$

It follows that

$$\frac{\partial \Gamma}{\partial z} = \frac{(\theta-1) A_{ji^E}^{\theta-2}}{z^{\theta-1} \int_{i^H}^1 A_{ji}^{\theta-1} di + \int_{i^E}^1 A_{ji}^{\theta-1} di} \frac{\partial A_{ji^E}}{\partial z} - \frac{A_{ji^E}^{\theta-1} (\theta-1) z^{\theta-2} \int_{i^H}^1 A_{ji}^{\theta-1} di}{\left[z^{\theta-1} \int_{i^H}^1 A_{ji}^{\theta-1} di + \int_{i^E}^1 A_{ji}^{\theta-1} di \right]^2},$$

which is negative if

$$\left[z^{\theta-1} \int_{i^H}^1 A_{ji}^{\theta-1} di + \int_{i^E}^1 A_{ji}^{\theta-1} di \right] A_{ji^E}^{-1} \frac{\partial A_{ji^E}}{\partial z} - z^{\theta-2} \int_{i^H}^1 A_{ji}^{\theta-1} di < 0,$$

or

$$\frac{\partial A_{ji^E}}{\partial i^E} \frac{\partial i^E}{\partial z} \frac{z}{A_{ji^E}} < \frac{z^{\theta-1} \int_{i^H}^1 A_{ji}^{\theta-1} di}{z^{\theta-1} \int_{i^H}^1 A_{ji}^{\theta-1} di + \int_{i^E}^1 A_{ji}^{\theta-1} di} \in \left[\frac{1}{2}, 1 \right].$$

Note that the RHS of this expression has a value beween $\frac{1}{2}$ and 1. Note also that

$$\frac{\partial i^E}{\partial z} \frac{z}{i^E} = \left[\frac{\partial a_{ji^E}}{\partial i} \frac{i}{a_{ji^E}} \right]^{-1},$$

and

$$\frac{\partial a_{ji^E}}{\partial i} \frac{i}{a_{ji^E}} = \frac{\partial A_{ji}}{\partial i} \frac{i}{A_{ji^E}} - \frac{\partial A_{ji}^*}{\partial i} \frac{i}{A_{ji^E}^*}.$$

Hence

$$\frac{\partial A_{ji^E}}{\partial i^E} \frac{i^E}{A_{ji^E}} \frac{\partial i^E}{\partial z} \frac{z}{i^E} = \frac{\frac{\partial A_{ji^E}}{\partial i^E} \frac{i^E}{A_{ji^E}}}{\frac{\partial A_{ji^E}}{\partial i^E} \frac{i^E}{A_{ji^E}} - \frac{\partial A_{ji^E}^*}{\partial i^E} \frac{i^E}{A_{ji^E}^*}}.$$

From this expression it can be inferred that

$$\frac{\partial A_{ji^E}}{\partial i^E} \frac{i^E}{A_{ji^E}} \frac{\partial i^E}{\partial z} \frac{z}{i^E} < \frac{1}{2}$$

is a sufficient condition that $\frac{\partial \Gamma}{\partial z} < 0$. Note that the sufficient condition is equivalent to

$$\frac{\frac{\partial A_{ji^E}}{\partial i^E}\frac{i^E}{A_{ji^E}}}{\frac{\partial A_{ji^E}}{\partial i^E}\frac{i^E}{A_{ji^E}} - \frac{\partial A^*_{ji^E}}{\partial i^E}\frac{i^E}{A^*_{ji^E}}} < \frac{1}{2},$$

or

$$\frac{\partial A_{ji^E}}{\partial i^E}\frac{i^E}{A_{ji^E}} < -\frac{\partial A^*_{ji^E}}{\partial i^E}\frac{i^E}{A^*_{ji^E}}.$$

Below it is shown that this condition is fulfilled when productivity is distributed according to the uniform density function.

Next consider the term

$$\begin{aligned}\frac{\partial\left(\varepsilon_{i^H,w}i^H + \varepsilon_{i^E,w}i^E\right)}{\partial z} &= \varepsilon_{i^H,w}\frac{\partial i^H}{\partial z} + \varepsilon_{i^E,w}\frac{\partial i^E}{\partial z} \\ &= \left(\varepsilon_{i^H,w} - \varepsilon_{i^E,w}\right)\frac{\partial i^H}{\partial z}.\end{aligned}$$

Since $\frac{\partial i^H}{\partial z} < 0$, a sufficient condition for $\frac{\partial\left(\varepsilon_{i^H,w}i^H + \varepsilon_{i^E,w}i^E\right)}{\partial z} < 0$ is that

$$\left(\varepsilon_{i^H,w} - \varepsilon_{i^E,w}\right) > 0,$$

or $\varepsilon_{a_{ji},i}$ is increasing in i. This holds for the uniform density, cf. below. It follows that a sufficient condition for

$$\frac{\partial \varepsilon_{L_j,W_j}}{\partial \tau} < 0,$$

is a uniform density for absolute productivity.

A uniform density for absolute productivity implies that

$$\begin{aligned}A_{ji} &= \frac{1}{\lambda} + (\lambda - \frac{1}{\lambda})i, \qquad \forall i \in [0,1], \\ A^*_{ji} &= \lambda - (\lambda - \frac{1}{\lambda})i, \qquad \forall i \in [0,1].\end{aligned}$$

Hence

$$\begin{aligned}\frac{\partial A_{ji}}{\partial i}\frac{i}{A_{ji}} &= \frac{(\lambda - \frac{1}{\lambda})i}{\frac{1}{\lambda} + (\lambda - \frac{1}{\lambda})i}, \\ \frac{\partial A^*_{ji}}{\partial i}\frac{i}{A^*_{ji}} &= \frac{-(\lambda - \frac{1}{\lambda})i}{\frac{1}{\lambda} - (\lambda - \frac{1}{\lambda})i},\end{aligned}$$

from which we have

$$\frac{\partial A_{ji}}{\partial i}\frac{i}{A_{ji}} < -\frac{\partial A^*_{ji}}{\partial i}\frac{i}{A^*_{ji}},$$

since

$$\frac{(\lambda - \frac{1}{\lambda})i}{\frac{1}{\lambda} + (\lambda - \frac{1}{\lambda})i} < \frac{(\lambda - \frac{1}{\lambda})i}{\frac{1}{\lambda} - (\lambda - \frac{1}{\lambda})i}.$$

Relative productivity can be written

$$a_{ji} = \frac{\frac{1}{\lambda} + (\lambda - \frac{1}{\lambda})i}{\lambda - (\lambda - \frac{1}{\lambda})i} = \frac{1 + (\lambda^2 - 1)i}{\lambda^2 - (\lambda^2 - 1)i},$$

and therefore

$$\begin{aligned}
\frac{\partial a_{ji}}{\partial i}\frac{i}{a_{ji}} &= \frac{(\lambda^2 - 1)\left[\lambda^2 - (\lambda^2 - 1)i\right] + (\lambda^2 - 1)\left[1 + (\lambda^2 - 1)i\right]}{\left[\lambda^2 - (\lambda^2 - 1)i\right]^2}\frac{i\left[\lambda^2 - (\lambda^2 - 1)i\right]}{\left[1 + (\lambda^2 - 1)i\right]} \\
&= \frac{(\lambda^2 - 1)\left(\lambda^2 + 1\right)}{\left[\lambda^2 - (\lambda^2 - 1)i\right]}\frac{i}{\left[1 + (\lambda^2 - 1)i\right]} \\
&= \left[(\lambda^2 - 1)\left(\lambda^2 + 1\right)\right]\frac{i}{\lambda^2 + (\lambda^2 - 1)^2(i - i^2)} > 0.
\end{aligned}$$

It follows that the sufficient condition for $\frac{\partial \varepsilon_{L_j,W_j}}{\partial z} < 0$ is fulfilled when productivity is uniformly distributed.