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Product market integration, rents and wage inequality

Torben M. Andersen and Allan Sørensen

School of Economics and Management
Aarhus University
Bartholins Allé 10, Building 1322
DK-8000 Aarhus C - Denmark
Phone +45 8942 1610
Mail: oekonomi@econ.au.dk
Web: www.econ.au.dk

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Torben M. Andersen
School of Economics and Management
Aarhus University
CEPR, EPRU and IZA

Allan Sørensen
School of Economics and Management
Aarhus University

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Abstract

Globalization in the form of product market integration affects labour markets and produces winners and losers. While there are aggregate gains, it is in general ambiguous how inequality is affected. We explore this issue in a Ricardian model and show that it depends on the balance between "protection" and "specialization" rents. In particular, wage inequality among similar workers (residual wage inequality) may be U-shaped, at first decreasing and then increasing in the process of product market integration. Consequently, there may be gains in both the efficiency and the equity dimension until integration reaches a certain level at which a trade-off arises.

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1 Introduction

The pros and cons of globalization[1] are vividly debated, and the labour market consequences are among the most persistent concerns. The standard response of economists is to point to aggregate gains accruing from further integration (reduction in trade frictions), but this answer is not very convincing to individuals facing the consequences of structural changes and increasing uncertainty wrt. future job and wage prospects - a point which cannot be neglected since the gains from further integration are intimately related to structural changes. Some activities contract and others expand in a process where allocation of production across countries becomes more closely aligned to comparative advantages. This process inevitably has both winners and losers via job destruction and creation as well as changing wage prospects. Is it inevitable that the gains from integration come at the cost of more inequality?

This question is fundamental and has been addressed in a large literature employing various trade models. One fairly robust conclusion is that high-skilled workers tend to be winners and low-skilled tend to be losers (at least relatively).[2] In particular, it has been argued that trade liberalizations partly account for the increasing wage gap between skilled and unskilled labour (see e.g. Feenstra and Hanson (2003) or OECD (2007) for a survey) and thus the increasing wage inequality.

This paper presents a complementary source of wage inequality arising from the effects product market integration has on product market rents. It is well established empirically that wages depend positively on firm specific factors like average value added per worker (see e.g. Abowd et al. (1999) and Fakhfakh and FitzRoy(2006)), and this link has been rationalized within search-matching, bargaining and efficiency wage models (see e.g. Blanchard and Giavazzi (2003) and Danthine and Kurmann (2004, 2007). It is also well-known that product market integration has important consequences for value added via both effects on market penetration (competition) and specialization (comparative advantage). We show within a standard set-up that this is closely related to two basic sources of rents to be shared in wage negotiations, namely rents created by limited market entry (henceforth protection rents) and rents created by having higher productivity (comparative advantage) than competitors (henceforth specialization rents)[3]. These two types of rents are obviously affected in different ways by product market integration since it squeezes protection rents via easier market penetration but fosters specialization rents via scope for exploitation of comparative advantages. These effects of globalization on wage rents and thus the wage inequality (distribution) go in opposite directions[4], and this may seem

[1] The term globalization captures many aspects and processes. In this paper we focus on product market integration induced by political and technological changes causing a decrease in variable trade costs.

[2] According to Baldwin (2006) this consensus view may be challenged due to offshoring.

[3] In imperfectly competitive markets with homogenous goods, rents are created to the extent that a firm can produce at costs lower than any competitor. The latter determines the "threat point" in terms of pricing, and this creates a rent for the lowest cost firm.

[4] A large number of empirical studies have analyzed how wage setting is affected by the

to leave ambiguous net effects. There is, however, a systematic relation between the importance of the two sources of rents and the degree of market integration since protection rents matter more in fairly closed economies (low level of market integration) while specialization rents matter more in more open ones (higher level of market integration). Hence, product market integration affects the relative importance of protection rents and specialization rents in a systematic way, and therefore a U-shaped relation between integration/openness and wage inequality may arise. That is, in a process of integration, wage inequality decreases at first due to a decline in the importance of protection rents, and increases later due to an increase in the relative importance of specialization rents. Combining this with the gains from trade (integration), it follows that the efficiency-equity trajectory at low levels of integration allows for increases in both efficiency and equity. However, at higher levels of integration a trade-off arises, and gains from integration are obtained at the costs of more inequality.

Our model combines two standard ingredients from the labour and the trade literature, respectively. Wage formation is modelled so as to imply rent sharing between employers and employees. Since there are no human capital differences, the focus is on so-called residual wage inequality[5], and product market integration is modelled as a reduction in trade frictions (Samuelson's iceberg costs) in an intra-industry trade model (closely related to the model in the seminal paper of Bernard, Eaton, Jensen and Kortum (2003) - henceforth BEJK(2003)). The framework is purposely kept standard to show that the basic effects and their systematic interrelation to product market integration arise from mechanisms well-known in the literature, and which in that sense are robust.

In a closely related paper, Egger and Kreickemeier (2008) analyze the effect of trade liberalization on residual wage inequality. They find that further integration increases residual wage dispersion. Their analysis differs from the present as it builds on the other workhorse model of international trade with heterogeneous firms (Melitz (2003)), and the wage setting is different. In our model wages increase in firm profitability (profits, revenue or valued added per worker) whereas they assume a fair wage increasing in firm specific marginal production efficiency. Neither the Melitz (2003) model with fixed labour costs of exporting nor the BEJK model produce a one-to-one relation between marginal production efficiency and profits, revenue or value-added per worker (see Schröder and Sørensen (2009)).

The rest of the paper is organized as follows: Section 2 develops the general

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trade position of firms, and have pointed to import threats exerting a downward pressure and export opportunities exerting an upward effect on wage setting. A number of studies have found that import penetration tends to lower wages (see e.g. Boulhol et al.(2006), Revenga (1992), Nicoletti et al. (2001) and Jean and Nicoletti (2002)). Bernard and Jensen (1999, 2001) and Bernard et al. (2003) find that exporting firms tend to have higher productivity and pay higher wages, with the causality running from productivity to exports. Interestingly, they also find that export tends to drive out less productive firms and induce a reallocation of production towards more efficient firms.

[5] To focus on the role of rents, we disregard human capital differences, which have been widely studied in the literature. Note moreover that human capital variables only account for a small part of total wage inequality. For a recent discussion see Lemieux (2006)).

equilibrium model and details the interaction between price and wage formation and product market integration. Section 3 presents the main results on the effects of product market integration on wage inequality. Section 4 concludes and briefly discusses possible extensions.

2 The Model

Consider a symmetric two-country setting (foreign variables are denoted by $*$) in which productivity of any given good is country/firm specific. The countries are assumed to be identical at aggregated levels to simplify the analysis and point out that the results are not driven by aggregate differences such as country size.

Each economy is composed of two parts; one which is not directly affected by product market integration (the home part H), and another which is directly affected by product market integration (the globalized part G).[6] The home-sector is perfectly competitive, and the commodity is not traded.[7][8] The wage in this sector is the alternative or outside option to workers in the G-sector. The alternative would be to introduce some unemployment benefit, but this would in turn involve financing via taxes and thus raise additional questions on how product market integration affects tax distortions. This is a separate issue, and to focus on the rent effect the adapted model approach is convenient.

The globalized part is described by a Ricardian framework with trade-frictions (see e.g. Dornbusch, Fischer and Samuelson (1977) or more recently BEJK (2003)) allowing an endogenous determination of the trade structure (non-tradeables, exportables, importables) and specialization. Trade involves various frictions in the form of explicit or implicit trade costs. It is assumed that trade frictions can be captured by Samuelson's iceberg costs. Hence, in order to deliver one output unit on the market abroad, one has to produce $1+z(\kappa)$ (≥ 1) units. Trade frictions are assumed to be symmetric with respect to the direction of trade and similar for all goods[9]. Trade frictions are a function of various factors affecting market integration κ, and we assume that $\frac{\partial z}{\partial \kappa} < 0$; i.e. κ is taken as an indicator for product market integration.

[6] A similar decomposition is made in Atkinson (2008) in a Heckscher-Ohlin model.

[7] The commodity could also be allowed to be traded at a zero trade friction without changing anything qualitatively or quantitatively.

[8] Blinder (2005) made a distinction between personal and impersonal services to highlight that certain activities are of such a nature that they cannot be traded (personal services e.g. taxi drivers, health care), while others can be traded if the explicit and implicit costs of doing so are not too large relative to comparative advantages. Besides, he argues that public services will be produced domestically for political reasons. Such activities are contained in the H-sector.

[9] The model can easily be generalized to allow for sector specific trade frictions, and the basic results on how firm specific wages are determined would be qualitatively the same.

2.1 Households

The utility function of a representative household is given by[10]

$$U = \frac{1}{\lambda^{\lambda}(1-\lambda)^{1-\lambda}} H^{1-\lambda} G^{\lambda} \qquad , \lambda \in [0,1]$$

where H is the consumption of home goods, and G is a consumption bundle of global goods. It is assumed that households supply one unit of labour inelastically and that labour is indivisible (disutility of work is thus constant and eliminated to simplify). The consumer price index is given by $Q = P_G^{\lambda} P_H^{1-\lambda}$.

The consumption bundle of global goods is defined as

$$G = \left(\int_0^1 C_i^{\frac{\epsilon-1}{\epsilon}} di \right)^{\frac{\epsilon}{\epsilon-1}} \qquad , \epsilon > 1 \tag{1}$$

where C_j is consumption of good type $i \in [0,1]$. The constant elasticity of substitution between any global goods is denoted ϵ. Accordingly, we have the following demand functions

$$C_i^d = \left(\frac{P_i}{P_G} \right)^{-\epsilon} \frac{\lambda I}{P_G}$$

where I is aggregate nominal income, P_i is the price for good i, and P_G is the price index of global goods defined as

$$P_G \equiv \left(\int_0^1 P_i^{1-\epsilon} di \right)^{\frac{1}{1-\epsilon}}$$

2.2 Firms in the globalized part (the G-segment)

Assume that for each good $i \in [0,1]$ there is one potential producer in each country; that is, we assume an international duopoly for each good. The production technique of the home firm potentially producing good i is given by a constant returns to scale production function with labour as the only input

$$Y_i = A_i L_i \tag{2}$$

where L_i is input of labour, and A_i is the (exogenous) firm specific productivity parameter (see e.g. BEJK(2003) and Melitz (2003) for some seminal trade models with exogenous heterogeneity in productivity across firms)[11].

Foreign production technology is similarly given as

$$Y_i^* = A_i^* L_i^* \tag{3}$$

[10] Profits are distributed to the households, and as preferences are homothetic, aggregate demand does not depend on the distribution of income/wealth and can thus be derived from a representative household.

[11] In fact, the product market formulation is a simplification of that in BEJK (2003). We consider the special case with two countries and one potential producer in each country.

where foreign productivity A_i^* in general differs from domestic productivity A_i in producing good i. Firms are in Bertrand competition, and we denote the revenue and employment of firm i by R_i and L_i, respectively.

2.3 Firms in the home part (the H-segment)

The home part of the economy is assumed to be perfectly competitive, and the representative firm produces subject to the following constant returns to scale production function with labour as the only input

$$Y_H = L_H$$

and due to perfect competition, we have

$$P_H = W$$

where W is the competitive market clearing wage.

2.4 The labour market

All workers are ex-ante alike and therefore have equal capabilities and opportunities of working in a given firm. The H-segment has a residual role - if unable to find a job in a G-firm, one can always turn to the (lower paying) H-segment. One can think of the H-segment as a service sector ("taxi drivers") or home production in which it is always possible to find a job. In this sense, there is always full employment.

Labour supply equals the number of households (normalized to unity); i.e. the clearing condition for the labour market reads

$$1 = L_H^d + L_G^d$$

where L_H^d is labour demand in the H-segment, and L_G^d is total labour demand from firms in the G-segment. The market clearing wage for the H-sector is as noted W.

Different approaches imply that firm specific wages come to depend on firm specific performance including value added per worker (see also the introduction). The two approaches used most often are a bargaining and a fair wage approach. The specific mechanism is not crucial to the main point of the paper, and we therefore specify the wage equation as

$$W_i = \alpha \frac{R_i}{L_i} + (1 - \alpha) W \tag{4}$$

where R_i is revenue generated in firm i, and α is the relative weight to the value added per worker, and $1 - \alpha$ the weight to the outside/reference wage. In Appendix A we show how this wage relation may be generated both from a bargaining model and a fair wage model. Similar type wage equations are obtained in bargaining models (see e.g. Blanchard and Giavazzi (2003), Andersen and Sørensen (2008)), search models (see Pissarides (2000)), and in fair wage models (see e.g. Danthine and Kurmann (2004, 2007) and De la Croix et al. (2007)).

2.5 Directions of trade and prices

Production generates a surplus to be shared between the firm and its workers. The wage equation (4) stipulates how the wage is set and thus how the surplus is to be shared. With no production the firm earns zero revenue and workers will be employed in the H-segment earning the competitive wage, W, and this determines the outside option. Accordingly the total surplus generated from production is given by

$$S_i = R_i - WL_i$$

where labour is valued at its oppotunity cost given by the competitive wage. Inserting the wage equation (4) into firm profits we find that

$$\Pi_i = R_i - W_i L_i = (1-\alpha)(R_i - WL_i) = (1-\alpha) S_i \tag{5}$$

The firm according to (5) receives a constant fraction $(1-\alpha)$ of the surplus from production and therefore maximization of profits is equivalent to maximization of the total surplus. Since the alternative use of labour is in the H-segment the marginal cost of labour relevant for maximizing surplus from production and thus profits is given by the competitive wage, W. Hence, although firms are heterogeneous and pay different wages in equilibrium due to labour market imperfections they all behave in pricing decisions as if they faced a competitive labour market with a wage of W.[12] Therefore, when considering firm behaviour below we refer to W as firms marginal costs of labour although we thereby slightly abuse terminology.

Under the assumption of Bertrand competition, it is fairly easy to determine the direction of trade; i.e. which of the global goods are produced in the home country and in the foreign country. As noted above, the relevant marginal cost of labour is the competitive wage, W. Thus, the relevant marginal cost of production is

$$MC_i = \frac{W}{A_i} \equiv \underline{P}_i$$

Accordingly, the marginal costs for the home firm (and similar for the foreign firm) are given by

$$\begin{array}{ll} \underline{P}_i & \text{in the home market} \\ \underline{P}_i (1+z) & \text{in the foreign market} \end{array} \tag{6}$$

Since prices are determined in Bertrand competition, the firm with the lowest marginal costs including trade frictions supplies a given market. Let $a_i \equiv \frac{A_i}{A_i^*}$ define the relative productivity between domestic and foreign firms (comparative advantage) and use that $W = W^*$, then the direction of trade is given by[13]

[12] Intuitively, firms take the endogeneous nature of firm specific wages into account in their pricing decisions and therefore marginal costs of labour differ from actual wages.

[13] For simplicity, it is assumed that if the marginal cost of supplying a market is identical for the firms, then only the domestic firm supplies the market.

Trade position	a_i
Import	$a_i < (1+z)^{-1}$
Non-traded	$(1+z)^{-1} \leq a_i \leq 1+z$
Export	$a_i > 1+z$

(7)

Lower trade frictions imply both an export possibility and an import threat. The export possibility arises for firms with relatively high productivity which become exporters; i.e. it becomes profitable to penetrate into the foreign market. The import threat arises for less productive non-tradeable firms being driven out of the market by foreign firms. It is an implication that the average productivity across operating firms increases, and thus that GDP increases when trade frictions fall. These implications of the model fit empirical evidence quite well (see e.g. Bernard, Jensen and Schott (2003)).

Pricing decisions are influenced by both the presence of trade frictions and the differences in productivity. As in the standard Bertrand game with constant returns to scale and perfect substitutes, the firm with the lowest marginal cost in a given market sets a price equal to the minimum of the monopoly price and the cost of the other firm. The monopoly prices (for the home firm) are

$$\begin{aligned} &m\underline{P}_i \text{ in the home market} \\ &m\underline{P}_i (1+z) \text{ in the foreign market} \end{aligned}$$

where m is the monopoly mark-up ratio defined as $m \equiv \frac{\epsilon}{\epsilon-1} > 1$. Note that the presence of the trade friction implies price differentiation between the home and foreign markets.

The consumers in the home country face the following prices for the goods in the consumption bundle (for proof see Appendix B)

$$P_i = \begin{cases} m\frac{W(1+z)}{A_i^*} & \text{if} \quad a_i < (1+z)^{-1} m^{-1} \\ \frac{W}{A_i} & \text{if} \quad (1+z)^{-1} m^{-1} \leq a_i \leq (1+z)^{-1} \\ \frac{(1+z)W}{A_i^*} & \text{if} \quad (1+z)^{-1} \leq a_i \leq m(1+z)^{-1} \\ m\frac{W}{A_i} & \text{if} \quad a_i > m(1+z)^{-1} \end{cases} \tag{8}$$

A change in trade frictions will thus affect prices both directly and indirectly (for given W). The indirect effects arise because the trade position of goods may change (non-tradeables affected by the possibility of import or export).

2.6 Wages

It follows straightforwardly from (4) and (8) that the wage is[14] (for proof see Appendix B)

$$W_i = \begin{cases} \left(\alpha\left(1+z\right)a_i + 1-\alpha\right)W & \text{if} \quad \frac{1}{1+z} \leq a_i \leq 1+z \\ \left(\alpha a_i \frac{(1+z)^{1-\epsilon}+1}{(1+z)^{-\epsilon}+(1+z)} + 1 - \alpha\right)W & \text{if} \quad 1+z < a_i \leq \frac{m}{1+z} \\ \left(\alpha a_i \frac{a_i^{\epsilon-1}m^{1-\epsilon}+1}{m^{-\epsilon}a_i^{\epsilon}+(1+z)} + 1-\alpha\right)W & \text{if} \quad \frac{m}{1+z} < a_i \leq m(1+z) \\ \left(\alpha m + 1 - \alpha\right)W & \text{if} \quad a_i > m(1+z) \end{cases} \tag{9}$$

Note that for $\frac{1}{1+z} > a_i$ there is no domestic production. The way wage rent generated in various firms $(\frac{W_i}{W})$ is related to the trade friction (z), and relative productivity (a_i) thus differs across sectors depending on their trade position (traded vs non-traded) and their market power. We return to a more detailed interpretation of the wage setting below.

2.7 General equilibrium

The equilibrium conditions to the model (for details see Appendix B) are given by the market clearing condition for all markets i

$$\begin{aligned} Y_H &= C_H^d \\ Y_i &= C_i^d \text{ for all non-tradeable sectors} \\ Y_i &= C_i^d + C_i^{*d} \text{ for all tradeable sectors} \end{aligned}$$

Total employment in the G-sector is

$$L_G = \int_0^1 L_i di$$

and the market clearing condition for the labour market reads

$$L_H + L_G = 1$$

3 Product market integration and wage inequality

The main interest here is the implications of product market integration for wage rents and thus wage inequality. We consider this in two steps. First, we work out the basic effects of product market integration on wage setting or rents in the various firms, and secondly we consider various measures of wage rents and inequality.

[14] Note that it is here implicitly assumed that $z_i \leq \sqrt{m} - 1 \equiv \tilde{z}_i$; that is, the relative productivity needed to be able to export is below the relative productivity needed to be able to charge the monopoly price in the home market. Hence, trade frictions are assumed to be small relative to the monopoly markup. We do not impose this restriction in the numerical analysis (see below).

3.1 Wages and integration

The wage rents generated in a given firm i can be expressed as $w_i = \frac{W_i}{W}$. A first observation is that wage rents are non-negatively related to productivity (comparative advantage). This is an unsurprising finding given that wage formation relates wages to value added per worker. Specifically, we have

$$\frac{\partial w_i}{\partial a_i} = \begin{cases} (\alpha(1+z)) > 0 & \text{if} \quad \frac{1}{1+z} \leq a_i \leq 1+z \\ \alpha \frac{(1+z)^{1-\epsilon}+1}{(1+z)^{-\epsilon}+(1+z)} > 0 & \text{if} \quad 1+z < a_i \leq \frac{m}{1+z} \\ \frac{\alpha\left[a_i^{\epsilon-1}m^{1-\epsilon}+1\right]}{m^{-\epsilon}a_i^{\epsilon}+(1+z)} + \frac{\left[\left[-m^{-\epsilon}a_i^{\epsilon}+(1+z)(\epsilon-1)m\right]a_i^{-1}m^{1}+\epsilon\right]m^{-\epsilon}a_i^{\epsilon-1}}{\left[m^{-\epsilon}a_i^{\epsilon}+(1+z)\right]^2} > 0 & \text{if} \quad \frac{m}{1+z} < a_i \leq m(1+z) \\ 0 & \text{if} \quad a_i > m(1+z) \end{cases} \tag{10}$$

More interesting is the fact that wage rents are also closely related to the extent of product market integration measured by the indicator for trade integration (κ) determining trade frictions (z) since we have

$$\frac{\partial w_i}{\partial \kappa} = \begin{cases} \alpha a_i \frac{\partial z}{\partial \kappa} < 0 & \text{if} \quad \frac{1}{1+z} \leq a_i \leq 1+z \\ \left(\alpha a_i \frac{(1+z)^{-2\epsilon}-1-\epsilon(1+z)^{1-\epsilon}\left[1-(1+z)^{-2}\right]}{\left[(1+z)^{-\epsilon}+(1+z)\right]^2}\right) \frac{\partial z}{\partial \kappa} > 0 & \text{if} \quad 1+z < a_i \leq \frac{m}{1+z} \\ -\frac{\alpha a_i^{\epsilon} m^{1-\epsilon}+1}{\left(m^{-\epsilon}a_i^{\epsilon}+(1+z)\right)^2} \frac{\partial z}{\partial \kappa} > 0 & \text{if} \quad \frac{m}{1+z} < a_i \leq m(1+z) \\ 0 & \text{if} \quad a_i > m(1+z) \end{cases} \tag{11}$$

Closer trade integration (higher κ) causes wage rents in non-tradeable sectors to fall. The reason is that lower trade frictions make it more difficult to appropriate rents in domestic markets since it is easier for foreign firms to penetrate into the domestic market, and this profit squeeze also affects workers. In the tradeable (export) sector, wage rents are non-decreasing in product market integration. The reason is that profits from exporting are non-decreasing since the trade friction absorbs some revenue, and hence lower frictions tend to lead to higher wages[15].

3.2 Wage rents and inequality

The above findings imply a systematic pattern between wage premia, relative productivity and trade positions, which in turn has important implications for how product market integration affects the wage distribution. First, note that the trade position of a firm for given trade frictions is related to relative productivity since very productive firms are exporters and the less productive produce

[15] Note that a change in the trade friction also on the margin includes sector shifts. At the productivity level where the firm becomes able to export, the wage curve has a discrete downward jump since the price and thus revenue per worker in the export market is lower than in the domestic market. A similar wage response appears in a right-to-manage model with perfect competition on the good markets, and in reciprocal dumping models (see e.g. Naylor (2000)) and within a Melitz (2003) model with the present labour market structure when taking labour devoted to fixed costs of exporting into account.

non-tradeables (and the least productive are not operational and substituted by imports). Hence, firms producing non-tradeables enjoy some protection due to trade frictions and this results in some wage premia for the workers (protection rents). However, this premium is decreasing when markets integrate since this forces firms to lower prices and hence value added per worker falls. For firms producing goods which are exported, the situation is opposite since these firms by definition have high relative productivity, and a lower trade friction causes wages to increase since workers reap some of the increased value added generated by lower trade frictions (specialization rents). Product market integration thus has opposite effects on the two types of rents.

To see the basic mechanisms involved, it is useful to start by considering the simplest metric of economy wide wage premia, namely the unweighted mean of wage rents (relative wages) generated in the various firms[16]. This is the metric coming closest to the relative wage between skilled and unskilled workers analysed in Heckscher-Ohlin models. We have

$$R_w \equiv \int_0^1 w_i di = \int_{i \in NT} w_i di + \int_{i \in E} w_i di \tag{12}$$

i.e. the wage rents generated are the sum of rents in firms producing non-tradeables and exportables, respectively. Here $NT \equiv \left\{ i \mid \frac{1}{1+z(\kappa)} \leq a_i \leq 1 + z(\kappa) \right\}$ and $E \equiv \{i \mid a_i > 1 + z(\kappa)\}$; i.e. NT gives the set of firms for which goods are produced at home but not traded, and E those produced at home and also exported. Similarly, $I \equiv \left\{ i \mid a_i < \frac{1}{1+z(\kappa)} \right\}$ gives the set of good types for which products are imported. Clearly, there is no domestic production for importable commodities, i.e. $Y_i = L_i = 0$ for $i \in I$.

Considering now the effects of product market integration on the mean rent, we have (see Appendix C)

$$\frac{\partial R_w}{\partial \kappa} \simeq \int_{i \in NT} \frac{\partial w_i}{\partial \kappa} di + \int_{i \in E} \frac{\partial w_i}{\partial \kappa} di \tag{13}$$

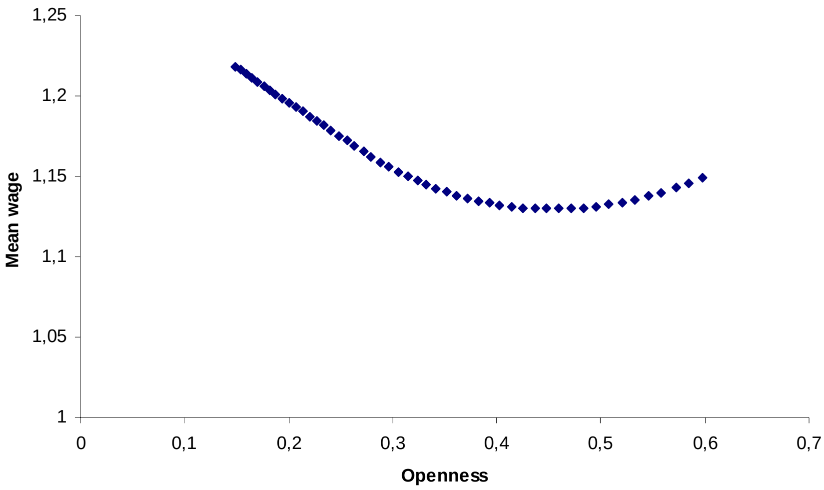
where the first term is negative ($\int_{i \in NT} \frac{\partial w_i}{\partial \kappa} di < 0$) since rents are squeezed in firms producing non-tradeables, and the second term is positive ($\int_{i \in E} \frac{\partial w_i}{\partial \kappa} di > 0$) since there is more scope for appropriating rents in the exporting firms. This gives a basic non-monotonicity between rents and the degree of market integration since we have (see Appendix C)

[16] Similar results obtain if defining some wage index $\widehat{W} = \left[\int W_i^{1-\lambda} \right]^{\frac{1}{1-\lambda}}$.

$$\frac{\partial R_w}{\partial \kappa} \longrightarrow \begin{cases} < 0 & \text{for} \quad z \longrightarrow \infty \\ \\ > 0 & \text{for} \quad z \longrightarrow 0 \end{cases}$$

From an initial position with low integration (high z), we thus have that product market integration tends to lower the mean rent or wage inequality, while at high integration (low z) further integration tends to increase rents and thus wage inequality. The basic intuition for this is that the balance between the two sources of rents changes, and since they are systematically related to the trade position of firms, it follows that reduction of protection rents matters most at initial stages of integration, while specialization rents dominate at high levels of integration.

Figure 1: Wage rents and integration



This result is illustrated in Figure 1 based on a simulation of the model.[17][18] In the simulations we measure product market integration (κ) and thus trade friction by the trade share in total production (H- and G-sector). This is straightforward as the trade share is monotonously decreasing in the trade friction (z) and thus increasing in the integration indicator (κ)[19][20]. Figure 1 shows that the metric of wage rents R_w is at first declining for low levels of openness

[17] The parameter choices underlying the simulation are as follows: The elasticity of substitution between goods is usually set in the range from 2 to 3 (Yi (2003)), and $\epsilon = 2.5$ is chosen. The bargaining power of the firms is assumed to equal that of the workers, i.e. $\alpha = \frac{1}{2}$. The income share spent on globalized goods λ is set to 0.6. Productivity is assumed to be lognormally distributed

$$\begin{pmatrix} \log A_i \\ \log A_i^* \end{pmatrix} \sim N\left[\begin{pmatrix} \mu \\ \mu \end{pmatrix}, \begin{pmatrix} \sigma^2 & \sigma_{12} \\ \sigma_{12} & \sigma^2 \end{pmatrix}\right]$$

and accordingly, relative productivity is also lognormally distributed

$$\log a_i \sim N\left[0, 2(1-\rho)\sigma^2\right]$$

where $\rho = \sigma_{12}/\sigma^2$. Throughout, we keep the mean and standard deviation of the productivity fixed such that $E(A_i) = 1$ and $\sigma_{A_i} = 0.75$ and $\rho = 0.85$. In the numerical work we approximate the continuum of goods with 1,000,000 goods.

[18] We have considered various extensions including different correlation between productivities between the two countries, differently sized countries, average productivity, different trade frictions for different commodities and relative size of the H-sector to the G-sector, and all these cases produced similar qualitative results for measures of wage inequality for the entire economy.

[19] In the simulations we consider 50 equally spaced values of z in the range of 0 to 0.5.

[20] Note that the level of openness associated with a given level of z depends on the distribution of relative productivity. We report results for a variation in the trade share or openness from 15% to 60%. This corresponds to a decrease of the trade friction z from 0.5 to 0. Note that an aggregate openness of 60% corresponds to full integration of the G-segment ($z = 0$).

and increasing for high levels of openness; i.e. product market integration makes R_w follow a U-shaped path.

The measure used above has the deed that it is simple, but it can be criticized for not taking into account both the weight of the different firms and the spread in rents across firms. Hence, it may be considered more appropriate to consider wage inequality within the G-sector measured by the variance of relative wages given as

$$V^G \equiv \int_0^1 v_i \left(w_i - \overline{w}_G\right)^2 di \tag{14}$$

where $\overline{w}^G \equiv \int_0^1 v_i w_i di$, and the firm i weight is given by its employment share in total G-sector employment, i.e. $v_i = \frac{L_i}{L_G}$. Wage inequality V^G is affected by product market integration as follows[21]

$$\frac{\partial V_G}{\partial \kappa} \simeq 2\int_{i\in NT} v_i \frac{\partial w_i}{\partial \kappa} di + 2\int_{i\in E} v_i \frac{\partial w_i}{\partial \kappa} di + \int_0^1 \frac{\partial v_i}{\partial \kappa}\left(w_i - \overline{w}_G\right)^2 di - 2\frac{\partial \overline{w}_G}{\partial \kappa} \lesseqgtr 0$$

This identifies four channels through which wage inequality measured by the variability of relative wages is affected by product market integration. The first two terms capture the same mechanisms as discussed above in relation to (13), namely that there is less rents in non-tradeable firms ($\int_{i\in NT} v_i \frac{\partial w_i}{\partial \kappa} di < 0$) and more rents in exportable firms ($\int_{i\in E} v_i \frac{\partial w_i}{\partial \kappa} di$). In addition, two new effects appear via (third term) a reallocation effect arising from changes in relative firm sizes ($\frac{\partial v_i}{\partial \kappa}$) weighted by their relative wage rent compared to its mean ($w_i - \overline{w}_G$), and it is generally ambiguously signed. Finally, there is the effect on the average relative wage in the G-sector, and this is in general ambiguously signed.

The important non-monotonicity effect generated by the two sources of rents and their systematic relation to trade positions identified above is thus at work, also in more general measures of wage rents or inequality, although additional effects appear. The same applies if considering the coefficient of variation[22], i.e.

$$CV_G = \sqrt{\int_0^1 v_i \left(\frac{w_i - \overline{w}_G}{\overline{w}_G}\right)^2 di} \tag{15}$$

or similar measures defined for the entire economy.

[21] The approximation arises by disregarding the terms arising from a marginal firm shifting trade status, cf (13).

[22] Using the standard measures (variance and standard deviation) implies that a proportional increase in all wages increases the inequality measure. One could argue that such an effect is undesirable as inequality is normally considered to be about the distribution of relative and not absolute wages. In the model, there is in fact an underlying increase in the wage level. The standard measures will therefore tend to overstate changes in inequality due to international integration. Note that since the coefficient of variation is invariant to a scaling of the wage, we get the same result irrespective of whether we consider the wage level or the wage premium.

Figure 2: Coefficient of variation for wage rents in the G-sector and for the entire economy

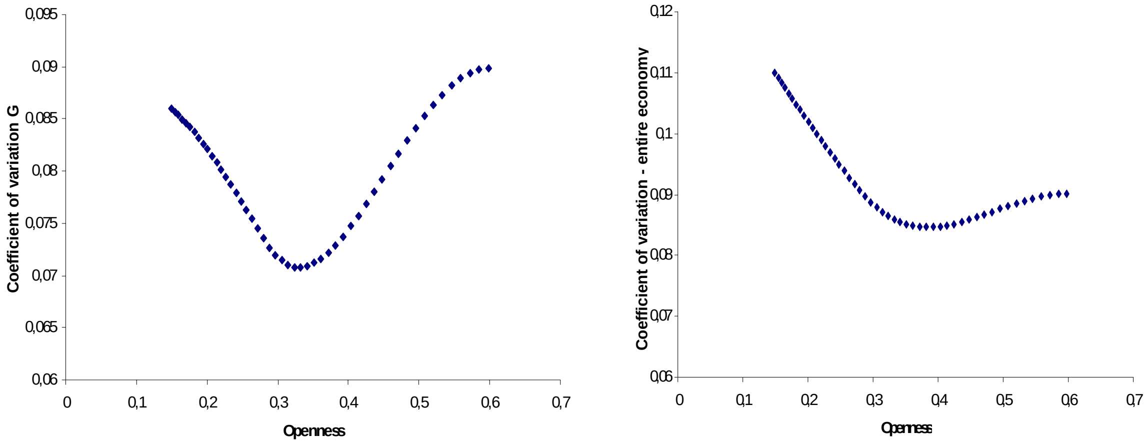


Figure 2 shows how the coefficient of variation for wages in the G-sector and the entire economy are affected by integration, and they are both seen to display a U-shape. The main point that there are two sources of wage rents which are affected differently by product market integration, and that this tends to generate a non-monotonicity since they are differently weighted at different levels of integration also arises for more general measures of wage inequality.

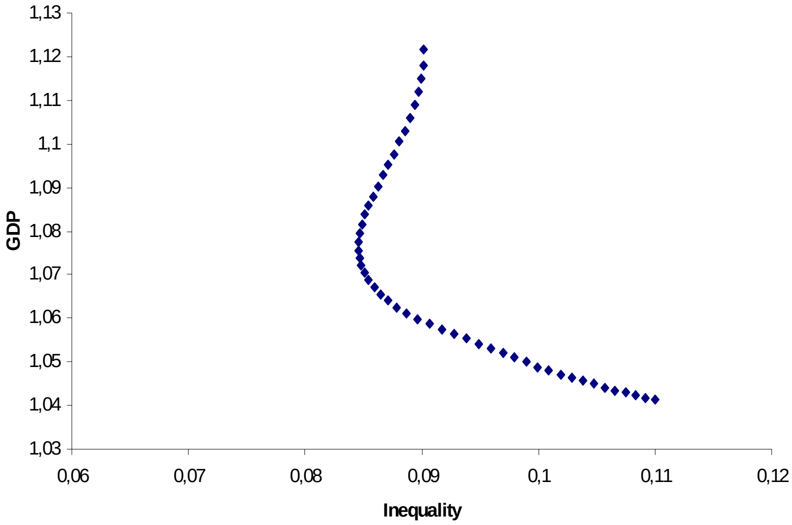
3.3 Integration and the efficiency-equity trade-off

The main findings can be summarized by means of Figure 3 showing the different positions in the efficiency-equity space for the economy depending on the level of openness. Efficiency is here measured by the mean income and equity by the coefficient of variation for wages in the entire economy[23]. Note that utility is proportional to income in the present framework. Lowering of trade frictions causes a movement from the "bottom" to the "top" of the curve. That is, first integration entails gains in both the efficiency and equity dimension, but at a certain level of integration a trade-off arises in the sense that further efficiency gains are achieved at the costs of rising inequality[24]. Hence, product market integration does not necessarily imply an efficiency gain at the cost of equity. However, for a sufficiently open economy it is the case that further integration implies that efficiency gains come at the cost of less equity.

[23] Note that the income measure is the sum of wage and profit income. Profit income is assumed to be distributed equally among all households, and hence the distributional dimension only refers to wage income.

[24] The turning point arises here for an openness measure of 35-40 %.

Figure 3: The efficiency-equity trajectory due to product market integration



4 Conclusion and extensions

This paper has shown that product market integration has different effects on two fundamental sources of wage rents, namely protection and specialization rents. Protection rents unambiguously fall, and specialization rents increase with product market integration. Since the role of these rents depends on the degree of product market integration, it has been shown that a U-shape may arise between various measures of wage inequality and product market integration (openness). That is, further product market integration in initially fairly closed economies is associated with less inequality due to the fact that protection rents are squeezed. However, further product market integration in fairly open economies will promote specialisation rents and therefore tend to increase wage inequality. An implication of this finding is that the efficiency-equity trajectory has that more integration leads to more efficiency (measured by e.g. meaning income) and equity at low levels of market integration. However, at higher levels of market integration a trade-off arises since further efficiency gains from market integration are associated with less equity (more inequality).

This non-linear relation suggests that it is not possible to make unambiguous statements about how openness affects inequality. However, it implies that when international integration or openness reaches a sufficiently high level, higher wage inequality is inevitable. The finding of a non-linear relation is also interesting from an empirical perspective both since there is evidence for some countries that inequality follows a U-path (see e.g. Atkinson (2003) and Alderson and Nielsen (2002))[25] and since it points to the danger of using a "linear" approach when trying to explain the development in inequality.

While illustrative, the present model rests on a number of simplifying assumptions which it would be necessary to generalize before proceeding to a genuine empirical assessment of the model. In particular, it would be interesting to introduce a richer labour market formulation allowing different types of labour as well as an endogenous determination of skills (education). This would allow us to analyze what happens to inequality between different and identical types of labour, and the short- and long-run consequences of international integration for inequality. It would also be interesting to analyze whether the predictions are robust to changes in the type of strategic interaction between firms; i.e. are the results robust to Cournot competition and Bertrand competition with differentiated products?

In future work, it would in particular be important to consider the role of unemployment. The present model has full employment implying that aggregate gains from integration and the implied increase in income lead to an increasing wage level (the dominant effect running via the H-sector), whereas in the presence of unemployment a larger share of the effect may show up in the employment level. This is important for the distributional consequences.

An important further step in addressing these issues would be to introduce the public sector explicitly in the analysis not least because this sector also should be considered a "home sector". Distributional concerns are a strong motivating factor behind many public sector schemes, and it is therefore of importance to analyze how both the need and scope for such schemes are affected by integration. This is needed to address the very important question whether the need for welfare state arrangements becomes stronger with further integration and in what way the scope for such policies is affected.

[25] It is difficult to infer anything on the role of international integration for inequality since it is also affected by other factors such as unionization, skill distribution, non-labour income and welfare policies. Hence, changes in inequality measures do not only arise from changes in labour market income, and this makes it very hard to draw precise conclusions. Moreover, part of the increase in labour earnings inequality from the mid 1980s to the mid 1990s can be explained by changes in employment and working hours since full-time labour earnings stayed rather constant (Williamson (2002)).

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5 Appendix A

This appendix shows how wage relations like (4) can be derived either from a bargaining set-up or from a fair/efficiency wage framework

Bargaining model

A search-matching approach implies that there is some locking-in effect once firms and workers have been matched, and accordingly wage setting comes to depend on firm specific factors (see e.g. Pissarides (2000). To simplify, we abstain from a detailed modelling of search frictions since this adds no qualitative differences to the resulting wage equation. The structure of the G-labour market is thus assumed to be as follows: ex ante identical workers apply for jobs (no job search costs), firms decide on employment and hire randomly among the applicants, and subsequently hiring/matching wages are negotiated with the workers. Note two implications of this structure. First, wages in any G-firm cannot be below the wage in the H-segment (W) since all workers can turn to this market on the spot. Hence, this market can also be seen as a simple way of introducing a minimum wage effect in wage setting. Second, job search is trivial in the sense that all workers ex ante would apply for jobs in any G-firm, and the allocation of workers across firms is random.

Utilizing the Nash bargaining model, we find that the bargaining outcome is given as the solution to

$$\max_{W_i \geq W} \left[R_i - W_i L_i\right]^{1-\alpha} \left[L_i \left(W_i - W\right)\right]^{\alpha} \tag{16}$$

where R_i is revenue, L_i is employment, W_i is the wage, and $\alpha \in [0, 1]$ is the relative bargaining power of the workers (see e.g. Moene and Wallerstein (1993)). The fall-back positions are determined by what happens in the case of no agreement. We assume that no production will take place and workers will find a job in the competitive H-segment. Thus, the fall-back positions are zero and W for firms and workers, respectively. Solving the bargaining problem yields the wage function

$$W_i = \alpha \frac{R_i}{L_i} + (1 - \alpha) W$$

Fair wages

Wage setting is assumed to follow so-called fair wage models (see Akerlof (1984)). Workers choose effort which for simplicity is assumed to take on two values $(0, \overline{e})$. The effort choice is determined by whether workers find that they renumerated fairly. Fairness is assessed in terms of a wage norm given as

$$W_i^n = \alpha \frac{R_i}{L_i} + (1 - \alpha) W \quad 0 < \alpha < 1$$

i.e. it depends on firm specific value added per worker and the outside option with weights α and $1 - \alpha$, respectively.

The effort choice of workers is thus given by

$$e_i = \begin{cases} \overline{e} \text{ if } W_i \geq W_i^n \\ 0 \text{if } W_i < W_i^n \end{cases}$$

Hence, the optimal strategy for the firm is to pay a wage $W_i = W_i^n$, and this holds for all i. More general versions of the fair wage model with the same qualitative implications are presented in Danthine and Kurmann (2004, 2007) and de la Croix et al. (2007).

6 Appendix B

From the standard Bertrand game with perfect substitutes and constant marginal costs, we know that the firm with the lowest marginal costs supplies the market. Since the reservation wage is identical in the two countries, differences in marginal costs depend on trade frictions and differences in productivity. The marginal cost of the home firm in the home market is given by

$$MC_{\text{home market}} = \frac{W}{A_i}$$

and for the foreign firm in the home market

$$MC^*_{\text{home market}} = \frac{W}{A_i^*}(1+z)$$

and accordingly the home firm supplies the home market if

$$MC_{\text{home market}} \leq MC^*_{\text{home market}} \Leftrightarrow a_i \geq (1+z)^{-1}$$

and the foreign firm supplies the home market if

$$a_i < (1+z)^{-1}$$

where

$$a_i = \frac{A_i}{A_i^*}$$

denotes relative productivity (comparative advantage). From the standard Bertrand game, we also know that the firm supplying the market sets the price equal to the smallest of the marginal costs of the other firm and the monopoly price. The monopoly prices for the home firm and foreign firm are given by (note that the consumer price index is normalized to one)

$$(P_i^*)^{\text{monopoly}}_{\text{home market}} = \arg\max_{P_i}\left(P_i - \frac{W}{A_i}\right)P_i^{-\epsilon}\lambda I P_C^{\epsilon-1} = \frac{\epsilon}{\epsilon-1}\frac{W}{A_i} = m\frac{W}{A_i}$$

$$(P_i^*)^{\text{monopoly}}_{\text{home market}} = \arg\max_{P_i}\left(P_i - \frac{W}{A_i}(1+z)\right)P_i^{-\epsilon}\lambda I P_C^{\epsilon-1} = \frac{\epsilon}{\epsilon-1}\frac{W}{A_i^*}(1+z) = m\frac{W}{A_i^*}$$

Now consider the cases where the home firm supplies the home market, that is, $a_i \geq (1+z)^{-1}$, then the price is given by

$$P_i = \min\left(\frac{W}{A_i^*}(1+z), m\frac{W}{A_i}\right) = \begin{cases} m\frac{W}{A_i} & \text{if} \quad a_i > \frac{m}{1+z} \\ \frac{W}{A_i^*}(1+z) & \text{if} \quad a_i < \frac{m}{1+z} \end{cases}$$

Consider now the cases in which the foreign firm supplies the home market, that is, $a_{ij} < (1+z_{ij})^{-1}$, then the price is given by

$$P_i = \min\left(\frac{W}{A_i}, m\frac{W}{A_i^*}(1+z)\right) = \begin{cases} m\frac{W}{A_i^*}(1+z) & \text{if} \quad a_i < \frac{1}{(1+z)m} \\ \frac{W}{A_i^*}(1+z) & \text{if} \quad a_i > \frac{1}{(1+z)m} \end{cases}$$

and hence we have

$$P_i = \begin{cases} m\frac{W(1+z)}{A_i^*} & \text{if} \quad a_i < (1+z)^{-1} m^{-1} \\ \frac{W}{A_i} & \text{if} \quad a_i \in \left[(1+z)^{-1} m^{-1}, (1+z)^{-1}\right) \\ \frac{(1+z)W}{A_i^*} & \text{if} \quad a_{ij} \in \left[(1+z)^{-1}, m(1+z)^{-1}\right) \\ m\frac{W}{A_i} & \text{if} \quad a_i > m(1+z)^{-1} \end{cases}$$

which are the prices in the paper. In exactly the same way, we calculate the prices in the foreign market.

Real wages

Note from the wage equation we have

$$W_i = \alpha\frac{R_i}{L_i} + (1-\alpha)W$$

and hence we need to calculate revenue and employment for each firm. Both can be calculated from the demand functions (note that all aggregate variables are identical in the two markets due to the aggregate symmetry assumption)

$$C_i^d = \lambda I P_C^{\epsilon-1} P_i^{-\epsilon}$$

$$\left(C_i^d\right)^* = \lambda I P_C^{\epsilon-1} (P_i^*)^{-\epsilon}$$

after correction for productivity and prices. Consider home firms and consider first a non-traded good, that is, $a_i \in \left[(1+z)^{-1}, 1+z\right]$, then

$$L_i = \lambda I P_C^{\epsilon-1} P_i^{-\epsilon}\frac{1}{A_i}$$

$$R_i = \lambda I P_C^{\epsilon-1} P_i^{-\epsilon} P_i$$

$$W_i = \alpha\frac{P_i^{-\epsilon}\lambda I P_C^{\epsilon-1} P_i}{P_i^{-\epsilon}\lambda I P_C^{\epsilon-1}\frac{1}{A_i}} + (1-\alpha)W = \alpha A_i P_i + (1-\alpha)W$$

where P_{ij} is determined in the paragraph above. Consider now a home firm exporting

$$L_i = P_i^{-\epsilon}\lambda I P_C^{\epsilon-1}\frac{1}{A_i} + (P_i^*)^{-\epsilon}\lambda I P_C^{\epsilon-1}\frac{1+z}{A_i}$$

$$R_i = \lambda I P_C^{\epsilon-1} P_i^{-\epsilon} P_i + \lambda I P_C^{\epsilon-1}(P_i^*)^{-\epsilon} P_i^*$$

$$W_i = \alpha \frac{P_i^{-\epsilon} P_i + (P_i^*)^{-\epsilon} P_i^*}{P_i^{-\epsilon} \frac{1}{A_i} + (P_i^*)^{-\epsilon} \frac{1+z_i}{A_i}} + (1-\alpha) W$$

where (P_i, P_i^*) is determined in the paragraph above. Inserting prices one obtains

$$W_i = \begin{cases} (\alpha (1+z) a_i + 1 - \alpha) W & \text{if} \quad \frac{1}{1+z} \leq a_i \leq 1+z \\ \left(\alpha a_i \frac{(1+z)^{1-\epsilon}+1}{(1+z)^{-\epsilon}+(1+z)} + 1 - \alpha\right) W & \text{if} \quad 1+z < a_i \leq \frac{m}{1+z} \\ \left(\alpha a_i \frac{a_i^{\epsilon-1} m^{1-\epsilon}+1}{m^{-\epsilon} a_i^{\epsilon}+(1+z)} + 1 - \alpha\right) W & \text{if} \quad \frac{m}{1+z} < a_i \leq m(1+z) \\ (\alpha m + 1 - \alpha) W & \text{if} \quad a_i > m(1+z) \end{cases}$$

if $z_i \leq z_i = \sqrt{m} - 1$ and

$$W_i = \begin{cases} (\alpha (1+z) a_i + 1 - \alpha) W & \text{if} \quad \frac{1}{1+z} \leq a_i \leq \frac{m}{1+z} \\ (\alpha m + 1 - \alpha) W & \text{if} \quad \frac{m}{1+z_{ij}} < a_{ij} \leq 1 + z_{ij} \\ \left(\alpha a_i \frac{a_i^{\epsilon-1} m^{1-\epsilon}+1}{m^{-\epsilon} a_i^{\epsilon}+(1+z)} + 1 - \alpha\right) W & \text{if} \quad 1+z < a_i \leq m(1+z) \\ (\alpha m + 1 - \alpha) W & \text{if} \quad a_i > m(1+z) \end{cases}$$

if $z > z$ (this condition determines whether a firm becomes able to charge the monopoly price in the domestic market before it becomes able to export).

7 Appendix C

We have that the mean wage is given as $R_w = \int_{i^I}^{i^E} w_i^{NT} di + \int_{i^E}^{1} w_i^E di$ where w_i^{NT} (w_i^E) denotes the wage paid in sector i if it is a non-tradeable (exportable). Since trade frictions are the same across sectors we can order the sectors such that relative productivity is increasing in i, and define i^I from $a_{i^I} = (1+z)^{-1}$ and $a_{i^E} = (1+z)$. Hence

$$\frac{\partial R_w}{\partial \kappa} = \int_{i^I}^{i^E} \frac{\partial w_i^{NT}}{\partial \kappa} di + \int_{i^E}^{1} \frac{\partial w_i^E}{\partial \kappa} di - w_{i^I}^{NT} \frac{\partial i_I}{\partial \kappa} + (w_{i^E}^{NT} - w_{i^E}^E) \frac{\partial i_E}{\partial \kappa}$$

where $w_{i^I}^{NT} \frac{\partial i_I}{\partial \kappa} > 0$ and $(w_{i^E}^{NT} - w_{i^E}^E) \frac{\partial i_E}{\partial \kappa} > 0$, hence $-w_{i^I}^{NT} \frac{\partial i_I}{\partial \kappa} + (w_{i^E}^{NT} - w_{i^E}^E) \frac{\partial i_E}{\partial \kappa} \lesseqgtr 0$. The latter term is taken to be second order and is left out from the expression in the text.

Let $\Psi \equiv \int_{i^I}^{i^E} \frac{\partial w_i^{NT}}{\partial z} di + \int_{i^E}^{1} \frac{\partial w_i^{E}}{\partial z} di$ and define $i^{EM} : m = a_{i^{EM}}(1+z)$. Hence

$$\Psi \longrightarrow \int_{i^I}^{i^E} \alpha a_i di \frac{\partial z}{\partial \kappa} < 0 \text{ for } z \longrightarrow \infty$$

$$\Psi \longrightarrow \int_{i^{EM}}^{1} -\frac{\alpha a_i^{\epsilon} m^{1-\epsilon} + 1}{\left(m^{-\epsilon} a_i^{\epsilon}\right)^2} \frac{\partial z}{\partial \kappa} di > 0 \text{ for } z \longrightarrow 0$$

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