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Torben M Andersen and Allan Sorensen

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Torben M Andersen, University of Aarhus and CEPR
Allan Sorensen, University of Aarhus

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Centre for Economic Policy Research
90–98 Goswell Rd, London EC1V 7RR, UK
Tel: (44 20) 7878 2900, Fax: (44 20) 7878 2999
Email: cepr@cepr.org, Website: www.cepr.org

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ABSTRACT

International Product Market Integration, Rents and Wage Formation*

International product market integration enhances both export possibilities through easier access to foreign markets, but also the import threat arising from foreign firms penetrating into the domestic market. These mechanisms affect wage formation and employment creation through many channels including product market rents and the possibility that jobs may be relocated across national labour markets. Possibilities and threats, however, will not in general be uniformly distributed across firms and therefore groups in the labour market. These issues are explored in a Ricardian trade model with imperfect competition, heterogeneity in the labour market, and decentralized wage-bargaining. The Paper analyses how product market integration affects wage formation, and identifies characteristics of winners and losers in the integration process.

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Torben M Andersen
Institute of Economics
Universitet Aarhus
Building 350
DK-8000 Aarhus C
DENMARK
Tel: (45 8) 942 1609
Fax: (45 8) 613 6334
Email: tandersen@econ.au.dk

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Allan Sorensen
Institute of Economics
Universitet Aarhus
Building 350
DK-8000 Aarhus C
DENMARK
Email: asoerensen@econ.au.dk

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1 Introduction

The process of globalization and how it affects labour markets and ultimately welfare is a very topical issue. While there is consensus that there are aggregate welfare gains to be reaped by international integration there is less agreement on the distributional consequences. However, since integration at the same time creates opportunities and threats it is unlikely that the consequences are going to be equally shared by all groups in the labour market. A key question is thus how wage formation and employment for various groups in the labour market are affected by international product market integration. From a labour market perspective the main opportunity (in the absence of labour mobility) created by tighter integration is the possibility of accessing foreign markets through exports, while the threat arises from the penetration of foreign firms into domestic markets via imports. Since all groups are not equally positioned in the labour market (revealed by initial differences in wages and employment prospects) it follows straightforwardly that international integration may have quite different effects across groups in the labour market. The aim of this paper is to take a first step from this general assertion to a better identification of the determinants affecting wage formation when product markets become more integrated. This is important not only from the positive perspective of identifying the consequences of international integration, but also from a normative perspective in providing essential information for consideration of policy initiatives needed to increase the gains and reduce the losses from international integration.

While the globalization process can be split into several processes such as increased capital mobility, increased product market integration, increased flow of information, etc., this paper focuses on international product market integration and especially on how it affects trade flows, wage determination and their interaction. This builds on two stylized facts concerning international integration. First, significant changes in labour mobility between labour markets in different countries have not been observed[1]. A prime example is Europe which in recent decades has experienced substantial product market integration, but although there is free mobility of labour, the observed mobility between European labour markets is quantitatively unimportant (OECD (1999)). Hence, mobility is not at present a major adjustment mechanism affecting labour markets, and the effects on labour markets would therefore have to arise via indirect channels related to the interaction between product and labour markets. Secondly, substantial integration of product markets has been observed following both political decisions and technological improvements. It is well-known that growth in trade has exceeded that of GDP for several decades. Two observations are important concerning the growing trade flows, namely, that trade remains concentrated within global regions such as EU, US, etc. (OECD (1999)), and that it increases in intra-industrial trade which is driving trade growth[2]. Hence,

[1] Changes in migration flows from low income countries to high income countries have been observed. Such immigration raises other issues also in a labour market context, which are not addressed in this paper.

[2] Even though inter-industrial trade is diminishing it does not follow that it is not impor-

there is growth in trade between relatively similar countries, and it seems to be driven by product differentiation, specialization, economies of scale, and abilities to improve production technology to maintain a competitive edge etc. In fact it has been documented for European countries that there is a tendency towards specialization of production (Midelfart-Knarvik et al. (2000)). Recent empirical work also contributes a central role to specialization and comparative advantages as a driving force for the growth in trade (see Davis and Weinstein (2002) and Yi (2003)). These changes originating in product markets may have important labour market implications since product market conditions are important both for employment creation and the rents to be bargained over in wage negotiations (see e.g. Dowrick (1981)).

Important insights on the relation between product markets and labour markets have been derived in the framework of the Heckscher-Ohlin model, and the well-known Stolper-Samuelson proposition has been widely used in discussing the consequences of international trade for wage inequality etc. (see e.g. Slaugther and Swagel (1997)). However, the underlying model framework derives trade from differences in factor endowments, and the model has its strength in accounting for inter-industrial trade. Labour market consequences in a setting of intra-industrial trade have been fairly extensively addressed within the framework of models of reciprocal dumping (see Brander (1981)) in which firms enter foreign markets (Cournot competition) to obtain a share of the product market rents. Lower trade frictions facilitate such reciprocal dumping which affects both the position and the slope of the labour demand, both of which are crucial for wage formation (see e.g. Andersen and Sørensen (2000)). While providing important insights on how product market integration may affect incentives in wage formation, the models crucially rely on Cournot competition and the empirical relevance of two-way trade is an open question (see Krugman (1995)). Moreover, this framework does not readily allow for an analysis of the distributional consequences of product market integration. The present paper aims to overcome these problems by considering product market integration within the framework of a Ricardian trade model with trade driven by differences in comparative advantages, in which product markets are imperfectly competitive (with either Bertrand or Cournot competition) and wages are determined by wage bargaining between workers and firms. This paper is related to Andersen (2003) but differs in an explicit modelling of imperfect competition in product markets and by considering wages to be determined through an explicit bargaining process between workers and firms rather than by being set

tant to wages. If competition between countries with different endowments is important for prices then product market integration (and hence just the possibility of trade) affects both employment and wages. However, relative prices of goods/industries possible subject to inter-industrial trade seem to be fairly stable as trade friction decreases (see Slaughter and Swagel (1997) for a survey). Feenstra and Hansson (2001) argue that it is misleading to restrict the analysis to prices of final goods. Further they show that trade in intermediates has increased and that import prices of these have fallen relative to domestic prices within industries indicating more use of low cost imported intermediates. Hence, we should expect the labour market to be affected by inter-industrial trade in intermediates. The model presented can straightforwardly be reinterpreted to have trade in intermediaries.

by monopoly unions[3]. The model features explicit trade frictions, and product market integration is interpreted as a process reducing these frictions.

The main mechanism through which product market integration affects labour markets is that both export possibilities from supplying foreign markets and import threats of foreigners penetrating into domestic markets via imports amounts to mobility of jobs. If market shares – in domestic or foreign markets – can be gained at the expense of foreign firms it follows that production and thus employment prospects improve, and vice versa. Put simply one might conjecture that export possibilities in general improve the wage and employment prospects while the import threat does the opposite. Some recent empirical work also supports these links. Bernhard and Jensen (1999) 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 to more efficient firms. Empirical studies have also found that import penetration tends to lower wages (see e.g. Revenga (1992), Nicolletti et al. (2001) and Jean and Nicoletti (2002). This is suggestive that product market integration may have contributed to the observed increase in wage inequality across both skill and geographical dimensions (OECD (2002)). Since the wage formation process is also observed to become more decentralized in many countries (see e.g. Booth et al. (2001)) it may be conjectured that these effects will work even more strongly in the future. The aim of this paper is to consider these issues by focussing on identifying the mechanisms through which export opportunities and import threats may affect wage formation. A particularly important issue is how sectors previously being shedded from international trade due to high trade frictions (non-tradeables) will be affected by lower trade frictions implying that some of these commodities become tradeables.

The paper is organized as follows: Section 2 develops a partial equilibrium model allowing for imperfectly competitive markets, trade frictions and heterogeneity in labour markets. The core of the paper is section 3 working out price and wage formation in the case of Bertrand competition in product markets. Section 4 briefly discusses how a shift from modelling product market interactions as Cournot rather than Bertrand competition affects the results. Section 5 presents the data used in the empirical analysis in section 6. Section 7 provides a brief conclusion and shortly discusses possible extensions. A number of appendices contain the technical details of the analysis.

2 The Model

Consider a two-country model, where countries are symmetric up to differences in productivity (comparative advantages), cf below. There is a continuum of

[3] Specifically the game theoretic notion of equilibrium underlying wage determination is refined from a conjectural variation approach in Andersen (2003) to a Nash-equilibrium for the decentralized wage bargaining problems.

goods indexed by $i \in [0,1]$. Each good can in principle be produced either at home or abroad, and can be imported or exported across countries. In equilibrium the allocation of production and trade patterns are determined endogenously depending on compartive advantages, relative factor prices, trade frictions etc. Trade involves various frictions in the form of explicit or implicit trade costs. Assume the trade frictions can be captured by Samuelsons iceberg costs denoted $z_i \geq 0$ for commodity i. Hence, in order to deliver one unit of commodity i on the foreign market $1 + z_i$ (≥ 1) units have to be produced, i.e. z_i captures a friction in international trade. Trade frictions are assumed to be symmetric with respect to the direction of trade. Integration of product markets can straightforwardly be analyzed as a reduction in z_i.

2.1 Demand

For each commodity $i \in [0,1]$ domestic and foreign demand are given by, respectively

$$\begin{aligned} D_i &= \left(\frac{P_i}{P}\right)^{-\epsilon} r \quad , \quad \epsilon > 1 \\ D_i^* &= \left(\frac{P_i^*}{P^*}\right)^{-\epsilon} r^* \quad , \quad \epsilon > 1 \end{aligned}$$

where a $*$ refers to the foreign market, P is the aggregate price level, and r the aggregate real income. In the following all aggregate variables are taken to be exogenous by price and wage setters, and therefore we can without loss of generality make the normalization that $r = r^* = P = P^* = 1$, that is, the analysis is partial. For a general equilibrium analysis in a similar framework but with perfectly competitive product markets see Andersen and Skaksen (2003). Given these assumptions demands can be rewritten

$$D_i = P_i^{-\epsilon} \tag{1}$$

$$D_i^* = P_i^{*-\epsilon} \tag{2}$$

To simplify goods are here presented as separate final consumption goods. A direct interpretation of the model would thus imply that it generates inter-industrial trade. However, it is straightforward to generate intra-industrial trade by assuming that there is a set of final goods which each are produced by a set of intermediaries, where the latter are modelled as here (for details see Andersen and Skaksen (2003)). Since this would not add additional insights but make the model presentation more complicated we simplify by not modelling this structure explicitly.

2.2 Production/Technology

Assume for each good $i \in [0,1]$ there is one potential producer in each country and they compete in either Bertrand or Cournot fashion, cf section 3 and 4,

respectively. The production technique available to the domestic firm to produce good i is given by the CRTS production function[4] with labour as the only input

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

where L_i is the input of firm specific labour and A_i is an exogenous firm specific efficiency/productivity parameter. Note that A_i can be interpreted as capturing different education, ability, or training levels of labour embedded in the firm specific type of labour or as reflecting differences in real capital (exogenous). Differences in A across firms can also be considered as a snap shot of differences related to technological advances, learning, economies of scale, etc. (see Grossman and Helpman (1995)). The production structure in the foreign country is similar, but productivity may differ ($A_i^* \neq A_i$), cf below. Note that it is determined endogenously whether a given commodity is produced at home, in the foreign country, or in both countries.

2.3 Wage setting

The sequencing of the model is such that firms hire labour and determine prices, and subsequently wages are negotiated. It is assumed that it is impossible ex ante to enter binding wage contracts, consequently wage bargaining would always take place at the firm level based on actual employment and realized rents. The wage is determined in a decentralized Nash bargaining between the firm and the workers. For each firm there is a group of workers (no mobility across firms/sectors) organized in a union negotiating the wage with the firm. Workers have a real reservation wage d and the aim of the union is to maximize the income generated above the reservation wage, i.e. $L_i (W_i - d)$, where W_i denotes the real wage rate, and L_i the employment level.

The total surplus generated by the production of good i to be shared between employers and employees is given by

$$S_i = R_i - L_i d$$

where R_i is total revenue from selling good i. The Nash bargaining procedure determines the wage as (see Moene and Wallerstein (1993))

$$W_i = \arg\max_{W_i \geq d} (R_i - W_i L_i)^{1-\alpha} (L_i (W_i - d))^{\alpha} = \alpha \frac{R_i}{L_i} + (1-\alpha) d \tag{4}$$

where $\alpha \in [0, 1]$ is the relative bargaining power of the workers (see e.g. Moene and Wallerstein (1993)). Note that the wage increases linearly (the slope depends on the bargaining power) in the revenue per worker (which equals the value of the marginal product of labour, but note that the firm is not a price

[4] Assuming decreasing returns would complicate the analysis by implying that some commodities simultaneously are produced in both countries and traded. There would still be one-way trade, but not perfect specialization for the production of traded goods, as is the case under constant returns to scale.

taker). This wage formula thus clearly brings out that there is sharing of the product market rents, and as will become clear below the latter depends critically on the trade position of the commodity in questions. The larger α the more the wage depends on revenue per worker and the less on the reservation wage.

3 Bertrand Competition

Consider the Bertrand case where the strategic variable of firms is the price. Given the sequential structure outlined above it follows that the firm in deciding on the price level recognizes that the wage is going to be determined according to (4).

Given the wage relation (4), the reduced form profit can be written

$$\Pi_i = R_i - W_i L_i = R_i - \alpha R_i - (1-\alpha) d L_i = (R_i - d L_i)(1-\alpha)$$

It follows that maximizing profits is equivalent to maximizing the surplus of production and hence the relevant marginal cost of production is

$$MC_i = \frac{d}{A_i} \equiv \underline{P}_i \tag{5}$$

The intuition is that since workers and the firm are sharing the rents via the wage agreement, it follows that the relevant cost component determining the marginal costs of production is the reservation wage of the workers.

To clarify the optimal pricing policy of the firm it is useful first to consider two limiting cases, namely, pricing at marginal costs and monopoly pricing.

Pricing at marginal costs is equivalent to charging the minimal price. Price differentiation arises between the home and foreign market since the trade frictions imply that the marginal cost of supplying the foreign market is $(1+z_i)$ times higher than the marginal cost of supplying the home market. Hence, the minimum price at which domestic firm i can supply to the market is given by

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

Consider next the monopoly prices giving the maximal price the firm would ever charge. When the domestic firm is the sole supplier of good i the problem of the firm is to maximize profit/surplus subject to (1)-(3) and (5), i.e.

$$\max_{P_i, P_i^*} \Pi_i = \left(P_i - \frac{d}{A_i}\right) P_i^{-\epsilon} + (P_i^*)^{-\epsilon} \left(P_i^* - \frac{d}{A_i}(1+z_i)\right)$$

The problem of finding the optimal price for the home and foreign market are separable (due to the constant returns to scale assumption) and accordingly we have that the monopoly prices are

$$\begin{aligned} &m\underline{P}_i \text{ in the home market} \\ &m\underline{P}_i (1+z_i) \text{ in the foreign market} \end{aligned} \tag{7}$$

where m is the monopoly mark-up ratio defined as $m \equiv \frac{\epsilon}{\epsilon-1} > 1$. Again the presence of the trade friction implies price differentiation between the home and foreign markets. It is a straightforward implication of the rent sharing underlying the wage formation that the wage rate is the highest when the firm enjoys a monopoly position in the product market. With the help of these two set reference prices we are able to derive the optimal pricing strategies.

3.1 Pricing strategies

In the Bertrand game it is a well-known result that the firm offering the good at the lowest price captures the entire market (in the absence of capacity constraints). Hence, it is crucial whether market entry is possible across markets, which here depends critically on the trade frictions and the marginal costs at which the commodities can be produced in the two countries. Obviously, marginal costs corrected for eventual trade frictions give the lowest prices at which firms can offer their commodities to the markets, and therefore determines how aggressively firms can be underbid the prices of competitors. It is therefore straightforward to work out when market penetration is possible. The domestic firm can penetrate into the foreign market (the export option) if the marginal costs at which the foreign market can be served are lower than the marginal costs of foreign firms, i.e.[5]

$$\underline{P}_i(1+z_i) < \underline{P}_i^*$$

or

$$1+z_i < a_i$$

where $a_i \equiv \frac{A_i}{A_i^*}$ defines the relative productivity/efficiency between domestic and foreign firms (comparative advantage). Similar reasoning implies that the foreign firm can penetrate into the home market (the import threat) if

$$\underline{P}_i > \underline{P}_i^*(1+z_i)$$

or

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

Finally, the commodity is a non-tradeable in the sense that the domestic firm serves the domestic market, and the foreign firm the foreign market if

$$\underline{P}_i^*(1+z_i)^{-1} \leq \underline{P}_i \leq \underline{P}_i^*(1+z_i)$$

or

$$(1+z_i)^{-1} \leq a_i \leq 1+z_i$$

Hence, if the domestic firm has a high relative efficiency (a_i) relative to the trade friction (z_i) in production it supplies both markets (the case of exportables), if it has an "average" relative efficiency it supplies the home market (the case of

[5] 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.

non-tradeables) and if the relative efficiency is low the firm does not produce at all and the product is imported (the case of importables).

The above conditions determine whether commodities would be traded (tradeables vs non-tradeables), and the direction of trade (exportables vs importables), but they do not determine the optimal price to charge. There are two reasons for this. First, for both tradeables and non-tradeables the firm may be able to charge the monopoly price, provided that its comparative advantage is sufficiently high (relative to the trade friction). Second, pricing is complicated by the presence of trade frictions, and due to comparative advantages and imperfect competition prices in the home and foreign market for tradeables may differ by more than the trade friction.

It can be shown that the optimal pricing policy and the implied wage rates for exportables are as given in table 1, and for non-tradeables as in table 2. Given the prices, the wage rate follows straightforward from (4).

Table 1: Prices and wages for exportables ($a_i > (1 + z_i)$)

	Price home	Price foreign	Wage rate
$a_i > m(1+z_i)$	$m\underline{P}_i$	$(1+z_i)m\underline{P}_i$	$[\alpha m + (1-\alpha)]\, d$
$a_i \leq m(1+z_i)$ $z_i > \tilde{z}_i$	$m\underline{P}_i$	$\underline{P}_i^*$	$\left[\alpha a_i \frac{a_i^{\epsilon-1} m^{1-\epsilon}+1}{m^{-\epsilon} a_i^{\epsilon}+1+z_i} + (1-\alpha)\right] d$
$\frac{m}{1+z_i} < a_i \leq m(1+z_i)$ $z_i \leq \tilde{z}_i$	$m\underline{P}_i$	$\underline{P}_i^*$	$\left[\alpha a_i \frac{a_i^{\epsilon-1} m^{1-\epsilon}+1}{m^{-\epsilon} a_i^{\epsilon}+1+z_i} + (1-\alpha)\right] d$
$a_i \leq m(1+z_i)^{-1}$ $z_i \leq \tilde{z}_i$	$(1+z_i)\underline{P}_i^*$	$\underline{P}_i^*$	$\left[\alpha a_i \frac{1+(1+z_i)^{1-\epsilon}}{(1+z_i)^{-\epsilon}+1+z_i} + (1-\alpha)\right] d$

where $\tilde{z}_i \equiv \sqrt{m} - 1$.

For exportables we have four cases. Firstly, if the comparative advantage is sufficiently strong, the firm is in a position where it can charge the monopoly price in both the home and the foreign market. The firm is simply so efficient relative to the foreign firm that the latter is unable to underbid even the monopoly price. Secondly, for moderate comparative advantages but sufficiently high trade frictions, the firm is able to enjoy a monopoly situation in the home market, but in the foreign market it must charge the marginal costs of the foreign firm. This is also the case for low trade frictions if the firm is sufficiently efficient, without being efficient enough to charge the monopoly price abroad. Finally, for moderate comparative advantages and low trade frictions the domestic firm cannot charge a price above the price at which the foreign firm can supply the two markets. Note that in all the cases referred to above there is generated a product market rent, i.e. prices in the domestic market are always above the marginal costs of the domestic firm. The wage rates corresponding to these different cases are interpreted in detail below.

The optimal price rules given in table 1 for exportables have two interesting implications. Firstly, the law of one price is in general violated due to trade

frictions, which is quite obvious. However, trade frictions do not automatically imply that the price of an exportable is higher in the foreign market than in the domestic market, since firms may charge prices depending on the competitors' marginal costs (to prevent market entry). Moreover, prices in domestic markets and foreign markets may be based on different marginal costs, as in for instance the second case in table 1. Secondly, imperfect competition and market entry implies that the exportable is never priced equal to domestic marginal costs, even in the domestic market.

Table 2: Prices and wage for non-tradeables ($(1+z_i)^{-1} \leq a_i \leq 1+z_i$)

	Price	Wage rate
$m < a_i(1+z_i)$	$m\underline{P}_i$	$[\alpha m + (1-\alpha)]\, d$
$m \geq a_i(1+z_i)$	$(1+z_i)\underline{P}_i^*$	$[\alpha(1+z_i)a_i + (1-\alpha)]\, d$

Turning to non-tradeables there are two possibilities, cf table 2. Either the firm enjoys a monopoly situation which is possible if the mark-up factor is not too large relative to comparative advantages and trade frictions, or the firm is forced to charge a price dictated by the lowest price at which the foreign firm can supply to the market which arises if the mark-up is sufficiently large relative to comparative advantages and the trade friction. In both cases some product market rent is generated since prices are always above the marginal costs of the domestic firm, but even though the domestic firm is the solely producer it cannot necessarily charge the monopoly price due to the threat of entry of the foreign firm. Finally, note that the case $m < a_i(1+z_i)$ can only arise if trade frictions are sufficiently large (necessary condition) $z_i > \tilde{z}_i$. Interestingly, the price of non-tradeables never equals domestic marginal costs, except in the knife edge case of $a_i = (1+z_i)^{-1}$.

3.2 Wage schedules

Given the results reported above on pricing and wage rates it is now possible to analyse the determinants of wages in more detail with the aim of working out implications of lower trade frictions for wage formation. The implied wage rates are seen most clearly by considering how wages depend on the comparative advantages, and therefore we consider the case of "low" ($z_i < \tilde{z}_i$) and "high" ($z_i \geq \tilde{z}_i$) trade frictions in turn.

3.2.1 "Low" trade frictions ($z_i < \tilde{z}_i$)[6]

The wage schedule can for this case be summarized as

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

It is seen that wages depend on relative productivity (comparative advantages) and not on absolute productivity. Figure 1 plots the wage rate as a function of comparative advantage (a_i).

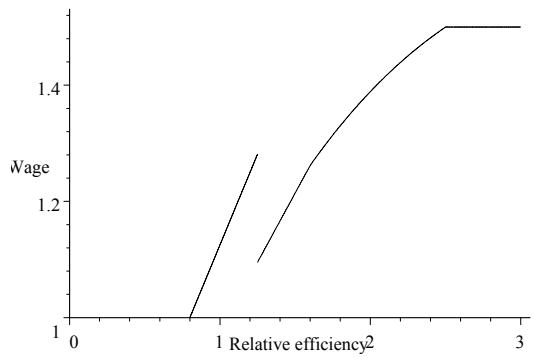

Figure 1: $W_i\left(a_i\right)$ for $d = 1, \epsilon = m = 2, \alpha = \frac{1}{2}, z_i = \frac{1}{4}$

Note that the wage curve depicted has a discontinuity at $a_i = (1+z_i)$, that is, wages are lower in firms which marginally manage to export compared to firms marginally maintaining a position as non-tradeables[7]. The intuition is straightforward. When a firm becomes sufficiently efficient to export it hires more workers and revenue per worker drops since the revenue per worker for the new workers producing for the export market is lower than for the workers producing for the home market due to trade frictions and the lower price charged to penetrate into the foreign market. Since wages depend on revenue sharing, see (4), the wage drops.

Two interesting observations can be made from figure 1. First, groups which are "closest" to the import threat ($a_i < 1$) have the lowest wages. Second, some workers in the non-tradeable sectors may have a higher wage than workers in firms exporting, despite the latter having a higher comparative advantage. That is, the wage is not monotonously increasing in the relevant measure of efficiency/productivity (comparative advantages). The reason is that this segment

[6] In this case it is possible that a firm is exporting without being able to charge the monopoly price in the domestic market, cf table 1.

[7] We have that $\frac{\partial W_i}{\partial a_i} \geq 0$ at all differentiable points. This is, however, not the case given Cournot competition.

of the non-tradeable firms does not have sufficiently high comparative advantage to make it into the export market, but still high enough to be fairly well shielded from market entry, and therefore product market rents are generated in the domestic market, and this is reflected in a higher wage rate.

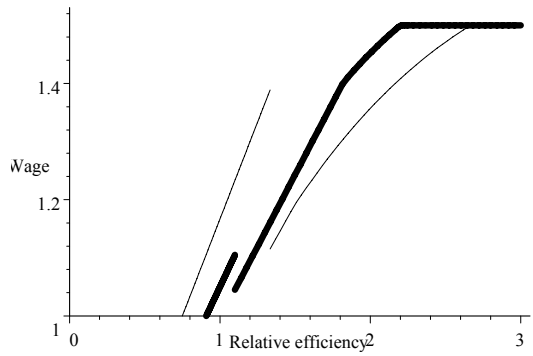

Figure 2: $W_i(a_i)$ for different values of z_i

Next we will analyze how a decrease in trade frictions affects the wage curve. Figure 2 illustrates (the solid graph is the one with lower trade frictions) how the wage curve moves when trade frictions are reduced. For all firms/groups maintaining their trade status, we find that the non-tradeable firms unambiguously face lower wages, while wages in exportable firms are either increasing or unchanged. Both effects are straightforward implications of lower trade frictions. For the non-tradeables the lower trade frictions imply that prices will have to be lowered since the price at which foreigners can produce to the domestic market falls. Hence, product market integration has effects also for firms not directly engaging in trade. For the most efficient exportable firms the wage is already initially at the "monopoly" level implied by monopoly pricing, and therefore the wage is unchanged. For the less efficient exportables revenue per worker increases because serving the export market absorbs less frictions. On the other hand home market revenue per worker is either decreasing or unchanged (unchanged if the monopoly price is charged at home). However, it can be shown that the foreign market effect dominates[8].

Some sectors shift trade status. For those with an initial low wage (comparative advantage) the competitive threat from foreign firms is stronger the lower the trade friction, hence the critical level of comparative advantage needed to maintain domestic production increases. Some forms of domestic non-tradeables production will thus close down (employment lost) and the domestic markets will be served by more efficient foreign firms. Other non-tradeable firms shift status to become exportables. Due to the discontinuity in the wage curve explained above, these groups will experience a fall in the wage rate, but employment will increase.

[8] If the firm initially charges $\underline{P}_i^*(1+z_i)$ on the home market see $\frac{\partial W_i}{\partial z_i}$ below and if the firm initially charges the monopoly price at home, but is forced to reduce it, see appendix A.

It is an implication of the changes outlined above that the number of non-tradeable firms shrinks, and both import and export increase as a consequence of lower trade frictions. Moreover, these adjustments are associated with more specialization between home and foreign production, and therefore a better allocation of production across countries according to comparative advantages.

To sum up more formally, a change in trade frictions affects wages in the following way (leaving out non-differentiable points)

$$\frac{\partial W_i}{\partial z_i} = \begin{cases} \alpha d a_i > 0 & \text{if} \quad \frac{1}{1+z_i} < a_i < (1+z_i) \\ -\alpha d a_i \frac{1-(1+z_i)^{-2\epsilon}+\epsilon(1+z_i)^{-\epsilon+1}\left(1-(1+z_i)^{-2}\right)}{\left((1+z_i)^{-\epsilon}+(1+z_i)\right)^2} < 0 & \text{if} \quad (1+z_i) < a_i < \frac{m}{1+z_i} \\ -\alpha d a_i \frac{a_i^{\epsilon-1} m^{1-\epsilon}+1}{\left(m^{-\epsilon} a_i^{\epsilon}+(1+z_i)\right)^2} < 0 & \text{if} \quad \frac{m}{1+z_i} < a_i < m(1+z_i) \\ 0 & \text{if} \quad a_i > m(1+z_i) \end{cases}$$

3.2.2 "High" trade frictions ($z_i \geq \tilde{z}_i$)[9]

If trade frictions are sufficiently high (implying that some non-tradeable firms can be in a monopoly situation) we have that the wage schedule is given by

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

and the dependence of the wage rate on comparative advantage is illustrated in figure 3.

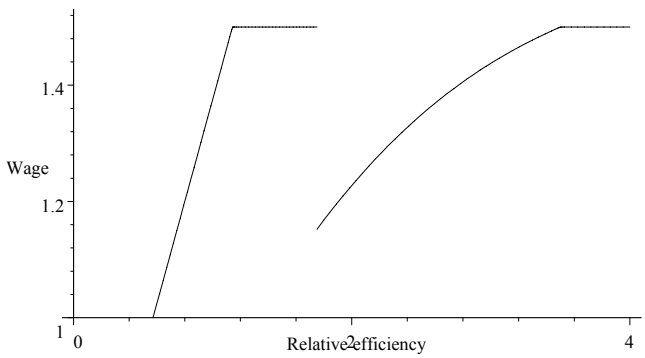

Figure 3: $W_i\left(a_i\right)$ given $d=1, \epsilon=m=2, \alpha=\frac{1}{2}$ and $z_i=\frac{3}{4}$

[9] With high trade frictions it is possible that a firm charges the monopoly price in the domestic market without being able to penetrate into the market abroad.

Also in this case there is a discontinuity in the wage curve at $a_i = (1 + z_i)$, the pivotal level of comparative advantages distinguishing non-tradeable and exportable firms. In this case the fall is from the "monopoly" wage, but the intuition is the same as in the case analyzed above.

Turning to the effects on wages of lower trade frictions we basically have the same types of effects as in the case considered above. The only additional qualitative insight is that the wage may be unchanged in some non-tradeable firms. The reason being that those maintaining a status as non-tradeables and being able to charge the monopoly price, still obtain the "monopoly" wage.

A further aspect arising for this case is that a reduction in trade frictions may imply a regime shift from the case $z_i \geq \tilde{z}_i$ to the case $z_i < \tilde{z}_i$. If this happens the wage function would change from the type depicted in figure 3 to the one in figure 1. That implies that wages in non-tradeable firms fall (if they are able to keep the monopoly price at home they will start to export) except if they become able to charge the monopoly price in the foreign market. For firms initially exporting the wage is either unchanged or increases. Counteracting effects arise if an exportable firm is forced to reduce the home price. In that case home market revenue per worker decreases, but foreign market revenue per worker increases. However, it can be shown that the foreign market effect dominates[10].

Again to sum up formally (without examining non-differential points) we have

$$\frac{\partial W_i}{\partial z_i} = \begin{cases} \alpha d a_i > 0 & \text{if} \quad \frac{1}{1+z_i} < a_i < \frac{m}{1+z_i} \\ 0 & \text{if} \quad \frac{m}{1+z_i} < a_i < 1 + z_i \\ -\alpha d a_i \frac{a_i^{\epsilon-1} m^{1-\epsilon}+1}{\left(m^{-\epsilon} a_i^{\epsilon} + (1+z_i)\right)^2} < 0 & \text{if} \quad 1 + z_i < a_i < m(1 + z_i) \\ 0 & \text{if} \quad a_i > m(1 + z_i) \end{cases}$$

3.2.3 Implications

The preceding analysis has taken its outset in a simple sharing rule for wage formation implying a positive one-to-one relationship between the measured value of productivity defined as $\frac{\Pi_i + W_i L_i}{L_i}$ and wages, in fact $W_i = \alpha \frac{\Pi_i + W_i L_i}{L_i} + (1 - \alpha) d$. However, once the value of productivity is related to underlying market characteristics including comparative advantages and trade frictions, the relation between wages and these underlying determinants becomes much more complex. This is so since these variables also determine the trade position of the firm and the competitive pressure it is facing from the foreign firm. One striking finding is that although wages are non-decreasing in productivity (comparative advantages) within the group of non-tradeable and exportable firms respectively, it is the case that workers in some non-tradeable firms can enjoy higher wages than in relative more efficient (in terms of comparative advantage) firms exporting. The intuition is straightforward since the value of production per worker is lower in the latter case than in the former. Hence, from the

[10] See appendix B.

worker's point of view it may not be advantageous that the firm (as a response to lower trade frictions) turns to the export market. However, even for workers the consequences of such a change are uncertain since these involve not only a decrease in wages but also an increase in employment.

Another general finding – across the two regimes considered above – is that workers in the low end of the wage distribution within non-tradeable sectors will lose their jobs as a consequence of a more effective import threat following product market integration. Those maintaining a non-tradeable position may experience a wage decrease (and never an increase), while those in firms already exporting may benefit through higher (never falling) wages. Note that although there is not a one-to-one relation between the trade position and wages, the lowest wages are always found in the least productive (low comparative advantage) segment of the non-tradeable sector.

Although not explicitly mentioned in the analysis above opposite moves in wage and employment as product markets become more integrated appear quite often in this setup, for instance when firms become able to export and when non-tradeables face harder foreign competition. Accordingly, when we are to determine winners and losers (expected winners and losers) in the process of market integration we have to consider both wages and employment prospects.

One final important observation. All the statements made above are conditional on both the relative productivity (comparative advantages) and trade frictions. Hence, for activities where trade frictions are high, the non-tradeable segment will be correspondingly larger, and vice versa for activities with low frictions.

4 Cournot competition

The preceding analysis was made under the assumption of price (Bertrand) competition between firms. Although this in many cases may seem to be the most realistic model for firm interaction, it is of interest to consider the extent to which the same type of results appear in the case of quantity (Cournot) competition. In the literature it has been suggested that the effects of product market integration under the two forms of competition may be quite different from a labour market perspective (see e.g. Pizer (2000)).

In appendix C the Cournot case is worked out in detail, but we summarize in figure 4 showing how the wage rate depends on comparative advantage for different levels of the trade friction.

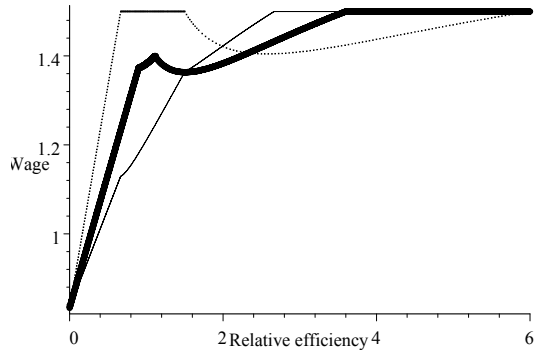

Figure 4: $W_i(a_i)$ given $\alpha = \frac{1}{2}, d = 1, \epsilon = m = 2$ and for different levels of z_i. The lines represent the low friction case, the thin one with lower z_i and the dots represent the high friction case.

It is seen that groups with low comparative advantage (the import threat) have lower wages than groups with high comparative advantage (the export possibility). However, the wage rate needs not be monotonously increasing in comparative advantage. The reason for this is that for "intermediate" levels of comparative advantages there are firms in the non-tradeable sector that generate product market rents which are reflected in higher wages.

One important difference between Bertrand and Cournot competition is that in the former case the wage falls when a firm starts to export but this is not so in the latter case. Given Cournot competition and sufficienty low trade frictions the wage increases as a firm starts to export. For sufficiently low trade frictions the wage is non-decreasing in relative productivity. However, except in this case neither the effects on wages of increased integration nor the intuition are as clear as in the Bertrand case. Workers in non-tradeables may still observe wage decreases (and never increases), but workers in exportables may observe both increases and decreases. The underlying mechanisms are more or less the same as in the Bertrand case, but the discontinuity when firms start to export is smoothened.

5 Conclusion

This paper has taken a first step in addressing the implications of product market integration in a setting allowing for imperfectly competitive markets, trade frictions and wage bargaining.

An important assumption underlying the analysis is that wage formation is decentralized and that the work force is firm-specific. The latter assumption can be interpreted in different ways. One possibility is that the productivity differences are reflecting firm specific human capital, in which case worker mobility would be inconsequential. The wage differences reflect in this case the rents workers can cash in by having acquired this firm/sector specific human

capital. The model can also be interpreted as capturing a situation with strong insider influence on wage formation (see Lindbeck and Snower, 2001) which is maintained due to high costs of replacing incumbent workers with outsiders (related to the human capital argument) or other forms of underbidding preventing mechanisms.

Another interpretation of the mobility assumption is to see this as the opposite of the even more extreme assumption (given that firm differences in wages are observed) of perfect mobility. Allowing for some mobility would then release a pressure for labour to move from firms/sectors experiencing wage declines to those experiencing increases. In this way the wage responses found in the present analysis can be seen as an indicator of the structural changes which will follow as a consequence of product market integration. The more rigid labour market adjustments are the more the consequences will be seen in wage differences.

The model has focussed on mobility of jobs via changes in market shares of domestic and foreign firms. However, such job mobility may also go via reallocation of firms either through FDI or outsourcing. However, the basic qualitative implications of job mobility for wage formation are captured by the approach taken here.

An interesting next step would be to embed this type of analysis into a general equilibrium framework. The partial approach taken here has the advantage of bringing forth some direct labour market implications, but the disadvantage of neglecting other consequences of product market integration as for instance the gains all would tend to get as consumers via lower consumer prices following more competition and specialization in production (see e.g. Andersen and Skaksen (2003)). A genereal equilibrium analysis would allow not only for an analysis of the consequences for aggregate wages and employment, but also of wage dispersion. In this context it would be interesting to allow for mobility of labour by having e.g. two types of labour – skilled and unskilled – one of which has firm-specific human capital, which cannot be transferred, and the other general skills, which can be transferred between firms.

6 Appendix A

Proof. Show that the wage increases, that is, show that

$$\frac{a_i^{\epsilon-1}m^{1-\epsilon}+1}{m^{-\epsilon}a_i^{\epsilon}+(1+z_i)} < \frac{(1+z_i^{new})^{1-\epsilon}+1}{(1+z_i^{new})^{-\epsilon}+(1+z_i^{new})} \text{ if } a_i \in \left(\frac{m}{1+z_i}, \frac{m}{1+z_i^{new}}\right]$$

Note that the left hand side (LHS) is continuous and differentiable in a_i. Note further that

$$\frac{d\,(LHS)}{da_i} = \epsilon m^{-\epsilon}a_i^{\epsilon-2}\frac{m^{-\epsilon}a_i^{\epsilon}+(1+z_i)-a_i^{\epsilon}m^{1-\epsilon}-a_i}{\left(m^{-\epsilon}a_i^{\epsilon}+(1+z_i)\right)^2} < 0$$

and hence $LHS\left(a_i, m\right) < LHS\left(1+z_i^{new}, m\right)$ for $a_i \in \left(\frac{m}{1+z_i}, \frac{m}{1+z_i^{new}}\right]$. So if

$$LHS\left(\frac{m}{1+z_i}, m\right) < \frac{\left(1+z_i^{new}\right)^{1-\epsilon}+1}{\left(1+z_i^{new}\right)^{-\epsilon}+\left(1+z_i^{new}\right)}$$

then we have proved that the wage increases.

$$LHS\left(\frac{m}{1+z_i}, m\right) = \frac{\left(1+z_i\right)^{1-\epsilon}+1}{\left(1+z_i\right)^{-\epsilon}+\left(1+z_i\right)}$$

However, $LHS\left(\frac{m}{1+z_i}, m\right)$ is continuous and strictly decreasing in z_i as

$$\frac{d\left(\frac{(1+z_i)^{1-\epsilon}+1}{(1+z_i)^{-\epsilon}+(1+z_i)}\right)}{dz_i} = \frac{\left(\left(1+z_i\right)^{-2\epsilon}-1\right)-\epsilon\left(1+z_i\right)^{1-\epsilon}\left(1-\left(1+z_i\right)^{-2}\right)}{\left(\left(1+z_i\right)^{-\epsilon}+\left(1+z_i\right)\right)^2} < 0$$

And since $z_i > z_i^{new}$ we have that

$$\frac{a_i^{\epsilon-1}m^{1-\epsilon}+1}{m^{-\epsilon}a_i^{\epsilon}+\left(1+z_i\right)} < \frac{\left(1+z_i\right)^{1-\epsilon}+1}{\left(1+z_i\right)^{-\epsilon}+\left(1+z_i\right)} < \frac{\left(1+z_i^{new}\right)^{1-\epsilon}+1}{\left(1+z_i^{new}\right)^{-\epsilon}+\left(1+z_i^{new}\right)}$$

■

7 Appendix B

Proof. Show that the wage increases, that is show that

$$\frac{a_i^{\epsilon-1}m^{1-\epsilon}+1}{m^{-\epsilon}a_i^{\epsilon}+\left(1+z_i\right)} < \frac{\left(1+z_i^{new}\right)^{1-\epsilon}+1}{\left(1+z_i^{new}\right)^{-\epsilon}+\left(1+z_i^{new}\right)} \text{ if } 1+z_i < a_i \leq \frac{m}{1+z_i^{new}}$$

Note that the left hand side (LHS) is continuous and differentiable in a_i. Note further that

$$\frac{d\left(LHS\right)}{da_i} = \epsilon m^{-\epsilon}a_i^{\epsilon-2}\frac{m^{-\epsilon}a_i^{\epsilon}+\left(1+z_i\right)-a_i^{\epsilon}m^{1-\epsilon}-a_i}{\left(m^{-\epsilon}a_i^{\epsilon}+\left(1+z_i\right)\right)^2} < 0$$

and hence $LHS\left(a_i, m\right) < LHS\left(1+z_i, m\right)$ for $a_i \in \left(1+z_i, \frac{m}{1+z_i^{new}}\right]$. So if

$$LHS\left(1+z_i, m\right) < \frac{\left(1+z_i^{new}\right)^{1-\epsilon}+1}{\left(1+z_i^{new}\right)^{-\epsilon}+\left(1+z_i^{new}\right)}$$

then we have proved that the wage increases.

$$LHS\left(1+z_i, m\right) = \frac{\left(1+z_i\right)^{\epsilon-1}m^{1-\epsilon}+1}{m^{-\epsilon}\left(1+z_i\right)^{\epsilon}+\left(1+z_i\right)}$$

Note that $LHS\left(1+z_i,m\right)$ is continuous in m and that

$$\frac{d\left(LHS\left(1+z_i,m\right)\right)}{dm}=\frac{\epsilon m^{-2\epsilon-1}\left(1+z_i\right)^{2\epsilon-1}\left(m-1\right)}{\left(m^{-\epsilon}\left(1+z_i\right)^{\epsilon}+\left(1+z_i\right)\right)^2}>0$$

However, we know that $z_i>z_i^*\Leftrightarrow m<\left(1+z_i\right)^2$ and accordingly we have that

$$LHS\left(1+z_i,m\right)<LHS\left(1+z_i,\left(1+z_i\right)^2\right)=\frac{\left(1+z_i\right)^{1-\epsilon}+1}{\left(1+z_i\right)^{-\epsilon}+\left(1+z_i\right)}$$

and finally we have that

$$\begin{aligned}\frac{a_i^{\epsilon-1}m^{1-\epsilon}+1}{m^{-\epsilon}a_i^{\epsilon}+\left(1+z_i\right)} &< \frac{\left(1+z_i\right)^{1-\epsilon}+1}{\left(1+z_i\right)^{-\epsilon}+\left(1+z_i\right)}<\frac{\left(1+z_i^{new}\right)^{1-\epsilon}+1}{\left(1+z_i^{new}\right)^{-\epsilon}+\left(1+z_i^{new}\right)}\\ \text{if } 1+z_i &< a_i\leq m(1+z_i^{new})^{-1}\end{aligned}$$

since $z_i>z_i^{new}$ and since $\frac{\left(1+z_i\right)^{1-\epsilon}+1}{\left(1+z_i\right)^{-\epsilon}+\left(1+z_i\right)}$ is continuos and decreasing in z_i

$$\frac{d\left(\frac{\left(1+z_i\right)^{1-\epsilon}+1}{\left(1+z_i\right)^{-\epsilon}+\left(1+z_i\right)}\right)}{dz_i}=\frac{\left(\left(1+z_i\right)^{-2\epsilon}-1\right)-\epsilon\left(1+z_i\right)^{1-\epsilon}\left(1-\left(1+z_i\right)^{-2}\right)}{\left(\left(1+z_i\right)^{-\epsilon}+\left(1+z_i\right)\right)^2}<0$$

■

8 Appendix C

8.1 Cournot competition

The model is the same as above except that firms now compete in a Cournot fashion. Hence, demands, production functions and wage settings are the same as above so we will focus on the product markets. The reduced form profits can be written as

$$\max\Pi_i=\left(Y_{i,H}\left(Y_{i,H}+Y_{i,H}^*\right)^{-\frac{1}{\epsilon}}+Y_{i,F}\left(Y_{i,F}+Y_{i,F}^*\right)^{-\frac{1}{\epsilon}}-\frac{d}{A_i}\left(Y_{i,H}+Y_{i,F}\left(1+z_i\right)\right)\right)(1-\alpha)$$

$$\max\Pi_i^*=\left(Y_{i,H}^*\left(Y_{i,H}+Y_{i,H}^*\right)^{-\frac{1}{\epsilon}}+Y_{i,F}^*\left(Y_{i,F}+Y_{i,F}^*\right)^{-\frac{1}{\epsilon}}-\frac{d}{A_i^*}\left(Y_{i,F}^*+Y_{i,H}^*\left(1+z_i\right)\right)\right)(1-\alpha)$$

Note that the markets can be analyzed separately, due to the CRTS production functions.

8.1.1 Home market

Consider first the home market. The first order conditions for the two firms are given by

$$\frac{\partial\Pi_i}{\partial Y_{i,H}}=\left(\left(Y_{i,H}m^{-1}+Y_{i,H}^*\right)\left(Y_{i,H}+Y_{i,H}^*\right)^{-\frac{1}{\epsilon}-1}-\frac{d}{A_i}\right)(1-\alpha)$$

$$\frac{\partial \Pi_i^*}{\partial Y_{i,H}^*} = \left(\left(Y_{i,H}^* m^{-1} + Y_{i,H} \right) \left(Y_{i,H} + Y_{i,H}^* \right)^{-\frac{1}{\epsilon}-1} - \frac{d}{A_i^*} \left(1 + z_i\right) \right) (1 - \alpha)$$

and inserting one in another (assuming that both firms produce in equilibrium) gives

$$Y_{i,H}^* = Y_{i,H} \frac{a_i \frac{1+z_i}{m} - 1}{\frac{1}{m} - a_i \left(1 + z_i\right)}$$

Note that both firms will not always produce in equilibrium and therefore we have

$$\frac{a_i \frac{1+z_i}{m} - 1}{\frac{1}{m} - a_i \left(1 + z_i\right)} < 0 \Leftrightarrow a_i < \frac{1}{\left(1 + z_i\right) m} < 1 \vee a_i > \frac{m}{1 + z_i}$$

Accordingly, we have three cases on the home market:

1) the home firm is the only supplier, that is $a_i > \frac{m}{1+z_i}$ and accordingly we have

$$Y_{i,H} = \left(\frac{A_i}{dm} \right)^{\epsilon}$$

$$\Pi_{i,H} = (1 - \alpha) \left(\frac{A_i}{dm} \right)^{\epsilon-1} \frac{m - 1}{m}$$

2) both firms supply that is $a_i \in \left[\frac{1}{(1+z_i)m}, \frac{m}{1+z_i} \right]$ and hence

$$Y_{i,H} = \left(\frac{A_i}{d} \right)^{\epsilon} \left(a_i \left(1 + z_i\right) - \frac{1}{m} \right) (2\epsilon - 1)^{\epsilon} \epsilon^{1-\epsilon} \left(1 + a_i \left(1 + z_i\right)\right)^{-1-\epsilon}$$

$$\Pi_{i,H} = \left(\frac{A_i}{d} \right)^{\epsilon-1} \left(a_i \left(1 + z_i\right) - \frac{1}{m} \right)^2 (2\epsilon - 1)^{\epsilon-1} \epsilon^{2-\epsilon} \left(1 + a_i \left(1 + z_i\right)\right)^{-1-\epsilon} (1 - \alpha)$$

3) only the foreign firm supplies that is $a_i < \frac{1}{(1+z_i)m}$

8.1.2 Foreign market

Consider first the home market. The first order conditions for the two firms are given by

$$\frac{\partial \Pi_i}{\partial Y_{i,F}} = \left(\left(Y_{i,F} m^{-1} + Y_{i,F}^* \right) \left(Y_{i,F} + Y_{i,F}^* \right)^{-\frac{1}{\epsilon}-1} - \frac{d}{A_i} \left(1 + z_i\right) \right) (1 - \alpha) = 0$$

$$\frac{\partial \Pi_i^*}{\partial Y_{i,F}^*} = \left(\left(Y_{i,F}^* m^{-1} + Y_{i,F} \right) \left(Y_{i,F} + Y_{i,F}^* \right)^{-\frac{1}{\epsilon}-1} - \frac{d}{A_i^*} \right) (1 - \alpha) = 0$$

and inserting one in another (assuming that both firms produce in equilibrium) gives

$$Y_{i,F}^* = \frac{\frac{a_i}{m} - \left(1 + z_i\right)}{\frac{1+z_i}{m} - a_i} Y_{i,F}$$

Note that both firms will not always produce in equilibrium and therefore we have

$$\frac{\frac{a_i}{m}-(1+z_i)}{\frac{1+z_i}{m}-a_i}<0 \Leftrightarrow a_i<\frac{1+z_i}{m} \vee a_i>m\left(1+z_i\right)$$

Accordingly, we have three cases on the foreign market

1) Only the home firm supplies, that is $a_i>m\left(1+z_i\right)$

$$Y_{i,F}=\left(\frac{A_i}{md\left(1+z_i\right)}\right)^{\epsilon}$$

$$\Pi_{i,F}=(1-\alpha)\left(\frac{A_i}{md\left(1+z_i\right)}\right)^{\epsilon-1}\frac{m-1}{m}$$

2) Both firms supplies, that is $a_i \in \left[\frac{1+z_i}{m}, m\left(1+z_i\right)\right]$

$$Y_{i,F}=\left(\frac{A_i}{d}\right)^{\epsilon}\left(a_i-\frac{1+z_i}{m}\right)\epsilon^{1-\epsilon}\left(2\epsilon-1\right)^{\epsilon}\left(1+z_i+a_i\right)^{-1-\epsilon}$$

$$\Pi_{i,F}=\left(\frac{A_i}{d}\right)^{\epsilon-1}\left(a_i-\frac{1+z_i}{m}\right)^{2}\epsilon^{2-\epsilon}\left(2\epsilon-1\right)^{\epsilon-1}\left(1+z_i+a_i\right)^{-1-\epsilon}\left(1-\alpha\right)$$

3) Only the foreign firm supplies, that is $a_i<\frac{1+z_i}{m}$

8.1.3 Wage schedules

As in the Bertrand case we have two cases: one with low trade frictions (that is $m>1+z_i$), and one with high trade frictions (that is $m<1+z_i$) which we will consider separately.

Low trade frictions The wage schedule can be deduced from above

$$W_i=\begin{cases} \alpha md+\left(1-\alpha\right)d & \text{if} \quad a_i>m\left(1+z_i\right) \\ d+\alpha d\frac{\frac{m-1}{m^{\epsilon}}+\left(a_i-\frac{1+z_i}{m}\right)^{2}\epsilon^{2-\epsilon}(2\epsilon-1)^{\epsilon-1}(1+z_i+a_i)^{-1-\epsilon}}{\frac{1}{m^{\epsilon}}+(1+z_i)\left(a_i-\frac{1+z_i}{m}\right)\epsilon^{1-\epsilon}(2\epsilon-1)^{\epsilon}(1+z_i+a_i)^{-1-\epsilon}} & \text{if} \quad \frac{m}{1+z_i}<a_i\leq m\left(1+z_i\right) \\ d+\frac{d\alpha\epsilon}{2\epsilon-1}\frac{\left(a_i-\frac{1+z_i}{m}\right)^{2}(1+z_i+a_i)^{-1-\epsilon}+\left(a_i(1+z_i)-\frac{1}{m}\right)^{2}(1+a_i(1+z_i))^{-1-\epsilon}}{\left(a_i(1+z_i)-\frac{1}{m}\right)(1+a_i(1+z_i))^{-1-\epsilon}+(1+z_i)\left(a_i-\frac{1+z_i}{m}\right)(1+z_i+a_i)^{-1-\epsilon}} & \text{if} \quad \frac{1+z_i}{m}\leq a_i\leq\frac{m}{1+z_i} \\ d+d\alpha\frac{\epsilon}{2\epsilon-1}\left(a_i\left(1+z_i\right)-\frac{1}{m}\right) & \text{if} \quad \frac{1}{m(1+z_i)}\leq a_i<\frac{1+z_i}{m} \\ 0 & \text{if} \quad a_i<\frac{1}{m(1+z_i)} \end{cases}$$

High trade frictions In this case the wage schedule is given by

$$W_i=\begin{cases} \alpha md+\left(1-\alpha\right)d & \text{if} \quad a_i>m\left(1+z_i\right) \\ d+\alpha d\frac{\frac{m-1}{m^{\epsilon}}+\left(a_i-\frac{1+z_i}{m}\right)^{2}\epsilon^{2-\epsilon}(2\epsilon-1)^{\epsilon-1}(1+z_i+a_i)^{-1-\epsilon}}{\left(a_i-\frac{1+z_i}{m}\right)\epsilon^{1-\epsilon}(2\epsilon-1)^{\epsilon}(1+z_i+a_i)^{-1-\epsilon}(1+z_i)+\left(\frac{1}{m}\right)^{\epsilon}} & \text{if} \quad \frac{1+z_i}{m}<a_i\leq m\left(1+z_i\right) \\ \alpha md+\left(1-\alpha\right)d & \text{if} \quad \frac{m}{1+z_i}<a_i\leq\frac{1+z_i}{m} \\ \alpha d\frac{\epsilon}{2\epsilon-1}\left(a_i\left(1+z_i\right)-\frac{1}{m}\right)+d & \text{if} \quad \frac{1}{m(1+z_i)}\leq a_i\leq\frac{m}{1+z_i} \\ 0 & \text{if} \quad a_i<\frac{1}{m(1+z_i)} \end{cases}$$

Note that in Cournot competition we have that

$$\frac{\partial W_i}{\partial a_i} \gtreqless 0$$

and hence the wage may be decreasing in relative efficiency although the trade characteristics of the firm do not change. Actually for sufficiently high trade frictions the wage is decreasing in relative efficiency in the low part of the region in which the firm charges the monopoly price at home and a competitive price abroad. The underlying intuition is that although revenue per worker on the foreign market increases and revenue per worker on the home market is unchanged the number of workers for the foreign market increases faster than for the home market and hence the average revenue per worker falls (if frictions are sufficiently high). The mechanism is actually the same as in the Bertrand case.

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