Product Market Integration, Wage Bargaining and Strike Activity*

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Abstract

We develop a spatial two-country model of wage determination with private information in unionized imperfectly competitive industries. We investigate the effects of separated product markets opening up for competition as well as of further market integration on the negotiated wage and the strike activity. We show that, when product markets are separated, the wage level and the strike activity are decreasing with the transportation cost and the home market size. However, when markets are integrated, wages and strikes are now increasing with the transportation cost. Finally, we find that the opening of markets for competition has an ambiguous impact on both the negotiated wage and the strike activity.

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1 Introduction

The labour market implications of European integration are of considerable importance. Since labour is not very mobile in Europe, the effects of international integration on labour markets are mostly indirect via product market integration. More competitive product markets would reduce the power in national labour markets, making them more competitive. Andersen et al. (2000) have found that integration gradually changes labour market structures and induces wage convergences as well as stronger wage interdependencies in wage formation among European countries.

In the present paper we investigate the effects of separated product markets opening up for competition as well as of further market integration on the negotiated wage and the strike activity. In order to do it, we develop a spatial two-country model of wage determination with private information in unionized imperfectly competitive industries.

In the literature, product market integration has been interpreted as a reduction in costs associated with international trade: transport costs, tariffs, taxes, information costs about foreign markets, etc. These costs could be divided into fixed costs or start up costs associated with exporting, and variable costs proportional to the level of exports. Naylor (1998) has shown that a decrease in variable export costs may give rise to a higher wage since a monopoly union responds by increasing the wage rate to the increased employment's demand. However, Huizinga (1993) and Sorensen (1993) have shown that a decrease in fixed costs, that implies the move from autarchy to fully integrated markets, would increase the degree of competition in the product market and, as Dowrick (1989) predicted, would reduce wages. More recently, Munch and Sorensen (2000) have shown that a reduction in fixed costs leads to an unambiguous decrease in wages, whereas a reduction in variable trade costs has an ambiguous effect on wages, due to the fact that the introduction of international competition for some goods neutralizes the effect on the employment's demand.

But, all these previous papers have used a complete information models which predict efficient outcomes of the bargaining process. In particular agreement is always settled immediately, so that strikes cannot occur at equilibrium.[1] This is not the case once we introduce private information into the wage bargaining, in which the first rounds of negotiation are used for information transmission between the two negotiators. So, the main feature of our model is that both the union and the firm have private information. Moreover, our model enables us to study the impact of product markets opening up for competition as well as of further market integration on wages and strikes.

[1] Strikes data seem to have a significant impact on the wage-employment relationship for collective negotiations. See e.g. Kennan and Wilson (1989), Vanrietebosch (1996).

We show that, when product markets are separated, the wage level and the strike activity are decreasing with the transportation cost and the country or market size. Moreover, since the union of the country with the biggest size has a higher employment level than the other country, this union will be willing to concede more rapidly during the wage negotiation and it will be more easy for the firm to screen the union's type. As a result, the strike activity tends to be smaller in the country with the biggest size.

However, when markets are integrated, wages and strikes are now increasing with the transportation cost. Indeed, when firms produce in related product markets, wage settlements create spillover effects by altering the firms' relative competitive positions in the product market[2]. The wage spillover effects create incentives to lower wages in order to gain a larger share of the product market and to induce more concessions and less strikes or lock-outs during the wage negotiations. Moreover, these incentives are stronger the smaller the transportation cost and the country size are. Therefore, once product markets are integrated, a marginal increase in product market integration modelled as a decrease in transportation costs will reduce the wage and the strike activity in both countries.

We also compare the strike activity when product markets are integrated with the strike activity when product markets are separated. We find that, the more amount of private information the firm and the union have and the smaller the transportation cost is, the more likely the strike activity will decrease when markets open up for competition. However, it is not excluded that theoretically, the strike activity might increase in one country and decrease in the other country when markets open up for competition. For example, if it is commonly known that the union is stronger than the firm and the private information is small enough, then the strike activity of the country with the smallest (greatest) market size will decrease (increase) when separated product markets open up for competition. Indeed, when separated product markets open up for competition, the biggest (the smallest) country will loose (gain) a substantial market share. As a consequence, the union of the biggest (the smallest) country will behave more aggressively (less aggressively) in wage negotiations in order to get a higher wage that compensates the anticipated lost in employment. Therefore, more (less) strike activity would result in the biggest (smallest) country.

Finally, we find, even for the complete information case, results that are contrary to previous results obtained in the literature. Indeed, we show that the opening of product markets for competition has an ambiguous impact on the negotiated wage level. If the countries sizes or initial markets sizes are different enough, then the opening of markets

[2] Davidson (1988) and Horn and Wolinsky (1988) were first to study the impact of wage spillover effects on the interaction of union-firm bargaining and duopolistic quantity-setting. Dowrick (1989) has studied how product market power and profitability are related to wages.

could increase (reduce) the wage outcome in the country with the biggest (the smallest) size.

The paper is organized as follows. In Section 2 the model is presented. The price game in the monopolistic and duopolistic markets are solved assuming that the wages have already been determined. Section 3 describes the wage bargaining game and solves this game for the case of two separated product markets. Section 4 is devoted to the wage bargaining game for the case of an integrated product market. Finally, Section 5 concludes.

2 The Model

We assume that there are two countries A and B and that in each country there is one firm producing a homogeneous good. The two firms are located on a Hotelling line with unit length. Firm A is located at the left extreme while firm B is located at the right end point of the unit interval. Consumers have non-negative linear transportation costs t per unit of distance. They are uniformly distributed along the interval and have density one. Consumers buy exactly one unit of the good. A consumer located at a distance x from firm A gets the following utility from buying the good to firm A:

$$v(t;x) = 1 - t \cdot x.$$

Let x_i denote the quantity produced by firm i, and let π_i denote the profit levels of each firm i $(i = A;B)$. Production technology exhibits constant returns to scale with labour as the sole input and is normalized in such a way that $x_i = l_i$, where l_i is labor input. The total cost to firm i of producing quantity x_i is $x_i \cdot w_i$, where w_i is the wage in firm i. In addition, each firm is unionized, and enters into an agreement with its risk-neutral union. The workforce for each firm is drawn from separate pools of labour, and the union objective is to maximize the economic rent, i.e.

$$U_i(w_i;\overline{w};l_i;(x_A;x_B)) = l_i \cdot (w_i - \overline{w}),$$

where $\overline{w}$ is the reservation wage. The profit of each firm is given by

$$\pi_i(w_i;l_i;(x_A;x_B)) = p_i \cdot x_i - w_i \cdot x_i.$$

Initially, the two countries constitute two separated markets with $k < 1$ and $(1 - k)$ being the market sizes of country A and country B, respectively. Interactions between the integration of product markets, the wage bargaining and the strike activity are analyzed according to the following game structure. In stage one, wages are determined by negotiations between the firm and the union in each country. In stage two, each firm chooses price, employment and output. The model is solved backwards.

In the last stage of the game, the wage levels have already been determined. When product market is not integrated each firm serves the consumers located in his own country (its whole market), and charges the monopoly prices. More precisely, at equilibrium we have

$$x_A^*(w_A) = \begin{cases} \frac{1-w_A}{2t} & \text{if } \frac{1-w_A}{2t} < k \\ k & \text{otherwise} \end{cases}, \quad x_B^*(w_B) = \begin{cases} \frac{1-w_B}{2t} & \text{if } \frac{1-w_B}{2t} < 1-k \\ 1-k & \text{otherwise} \end{cases},$$

and

$$p_A^*(w_A) = \begin{cases} \frac{1+w_A}{2} & \text{if } \frac{1-w_A}{2t} < k \\ 1-kt & \text{otherwise} \end{cases}, \quad p_B^*(w_B) = \begin{cases} \frac{1+w_B}{2} & \text{if } \frac{1-w_B}{2t} < 1-k \\ 1-(1-k)t & \text{otherwise} \end{cases}.$$

Throughout the paper we will focus on the more interesting case, namely the case where a monopolist would like to cover the entire integrated market. This assumption reverts to consider only the equilibrium where $x_A^* = k$, $x_B^* = (1-k)$, $p_A^* = 1-kt$ and $p_B^* = 1-(1-k)t$. So, when markets are separated, both firms are constrained by their respective market size and are covering their entire home market. Hence, the equilibrium output of each firm coincides with its market size and does not depend on the transportation cost. An increase in the transportation cost reduces the utility of consumers from buying the good and the monopolistic price that the firm can charge.

When product markets are integrated, both firms compete by choosing simultaneously their prices to maximize profits. The unique (interior) Nash equilibrium of this stage game yields

$$p_i^*(w_A; w_B) = \frac{2w_i + w_j + 3t}{3} \text{ and } x_i^*(w_A; w_B) = \frac{w_j - w_i}{6t} + \frac{1}{2}$$

with $i, j = A, B$, $i \neq j$. The Nash equilibrium output of each firm (and hence, equilibrium level of employment) is decreasing with the transportation cost and with its own wage, while it is increasing with the other firm's wage. In case of $w_i = w_j$, the equilibrium output will be constant and equal to $\frac{1}{2}$. Finally, notice that, contrary to the case of separated product markets, an increase in the transportation cost reduces now the degree of competition between firms and increases the prices that both firms can charge.

In the first stage of the game, firms and unions negotiate the wages foreseeing perfectly the effect of wages on the decisions concerning output and employment. To investigate the consequences of product market integration on the negotiated wage and the strike activity, we analyze first the wage negotiations when both markets are separated.

3 Two Separated Markets

In each country, the wage negotiation proceeds as in Rubinstein's (1982) alternating-offer bargaining model. The firm and the union make alternatively wage offers, with the firm

making offers in odd-numbered periods and the union making offers in even-numbered periods. The negotiation ends when one of the negotiators accepts an offer. No limit is placed on the time that may be expended in bargaining and perpetual disagreement is a possible outcome. The union is on strike in every period until an agreement is reached. Both negotiators are assumed to be impatient. Indeed, the firm and the union have time preferences with constant discount rates $r_f > 0$ and $r_u > 0$, respectively. We assume that the unions of both countries have the same discount rate r_u and the firms of both countries have also the same discount rate r_f.

As the interval between offers and counteroffers is short and shrinks to zero, the alternating-offer model has a unique limiting subgame perfect equilibrium, which approximates the Nash bargaining solution to the bargaining problem (see Binmore et al., 1986). Thus the predicted wage is given by

$$w_{s,i}^{SPE} = \arg\max [U_i - U_0]^{\beta} [\pi_i - \pi_0]^{1-\beta},$$

where the lowerscript "s" means that product (and labour) markets are separated and wage bargaining is made independently in each country, where $U_0 = 0$ and $\pi_0 = 0$ are the status-quo payoffs, and where $i = A, B$. The parameter $\beta \in (0,1)$ is the union bargaining power which is equal to $\frac{r_f}{r_u + r_f}$, and it is the same for both unions. Simple computation gives us

$$w_{s,A}^{SPE} = \overline{w} + \frac{\beta}{2}[(1-\overline{w})(3-\beta) - 4tk] = \overline{w} + \frac{r_f}{(r_u + r_f)}\left[\frac{(1-\overline{w})}{2}\frac{(3r_u + 2r_f)}{(r_u + r_f)} - 2tk\right] \quad (1)$$

and

$$w_{s,B}^{SPE} = \overline{w} + \frac{r_f}{(r_u + r_f)}\left[\frac{(1-\overline{w})}{2}\frac{(3r_u + 2r_f)}{(r_u + r_f)} - 2t(1-k)\right] \quad (2)$$

Expressions (1) and (2) tell us that, when a monopolist would cover the entire market if both markets were integrated, then the equilibrium wage in each country is increasing with the reservation wage $\overline{w}$ and with the union bargaining power β, but is decreasing with the transportation cost t and with its market size. Notice also that, if both countries or markets are of the same size, i.e. $k = \frac{1}{2}$, then the equilibrium wages coincide.

Knowing the equilibrium wage, one can easily obtain the equilibrium payoffs, which are given by

$$U_{s,A}^{*}(\beta) = \frac{\beta}{2}[(1-\overline{w})(3-\beta) - 4tk] \equiv k,$$

$$\pi_{s,A}^{*}(\beta) = \frac{k}{2}[(1-\overline{w})(2-\beta(3-\beta)) - 2tk(1-2\beta)],$$

for country A, and given by

$$U_{s,B}^{*}(\beta) = \frac{\beta}{2}[(1-\overline{w})(3-\beta) - 4t(1-k)] \equiv (1-k),$$

$$\Pi^{*}_{s,B}(\alpha) = \frac{(1-k)}{2}[(1-w)(2-\alpha(3-\alpha)) - 2t(1-k)(1-2\alpha)],$$

for country B. In both countries the union and the firm equilibrium payoffs are decreasing with t and with w. Meanwhile each firm equilibrium payoff is decreasing with the union bargaining power and increasing with its market size, each union equilibrium payoff is increasing with its bargaining power but could be increasing or decreasing with the market size. Precisely, the union equilibrium payoff is increasing with the market size of its firm if and only if the market size is smaller than $(3-\alpha)(1-w)[8t]^{-1}$. Finally, since we are considering the case where a monopolist would cover the entire market if both markets were integrated, the equilibrium employment of each firm coincides with its home market size.

Strikes data seem to have a significant impact on the wage-employment relationship for collective negotiations. See e.g. Kennan and Wilson (1989), Vannetelbosch (1996). However, both the asymmetric Nash bargaining solution and the Rubinstein's model predict efficient outcomes of the bargaining process. In particular agreement is settled immediately, so that strikes cannot occur at equilibrium. This is not the case once we introduce private information into the wage bargaining, in which the first rounds of negotiation are used for information transmission between the two negotiators.

The main feature of the negotiation is that both negotiators have private information. Each negotiator does not know the impatience (or discount rate) of the other party. It is common knowledge that the firm's discount rate is included in the set $[r_f^P; r_f^I]$, where $0 < r_f^P \leq r_f^I$, and that the union's discount rate is included in the set $[r_u^P; r_u^I]$, where $0 < r_u^P \leq r_u^I$. The superscripts "I" and "P" identify the most impatient and most patient types, respectively. The types are independently drawn from the set $[r_j^P; r_j^I]$ according to the probability distribution p_j, for $j = u,f$. We allow for general distributions over discount rates. This uncertainty implies bounds on the union bargaining power which are denoted by $\underline{\alpha} = \left[r_f^P \oplus r_u^I + r_f^P\right]^{-1}$ and $\overline{\alpha} = \left[r_f^I \oplus r_u^P + r_f^I\right]^{-1}$.

Lemma 1 (Separated markets) Consider the wage bargaining with private information in which the distributions p_f and p_u are common knowledge, and in which the period length shrinks to zero. For any perfect Bayesian equilibria (PBE), the payoff of the union belongs to $\left[U^{*}_{s,c}(\underline{\alpha}); U^{*}_{s,c}(\overline{\alpha})\right]$ and the payoff of the firm belongs to $\left[\Pi^{*}_{s,c}(\overline{\alpha}); \Pi^{*}_{s,c}(\underline{\alpha})\right]$.

This lemma follows from Watson's (1998) analysis of Rubinstein's alternating-offer bargaining model with two-sided incomplete information.[3] As Watson (1998) stated, Lemma

[3] Watson (1998) characterized the set of PBE payoffs which may arise in Rubinstein's alternating-offer bargaining game and constructed bounds (which are met) on the agreements that may be made. The bounds and the PBE payoffs set are determined by the range of incomplete information and are easy to

1 establishes that "each player will be no worse than he would be in equilibrium if it were common knowledge that he were his least patient type and the opponent were his most patient type. Furthermore, each player will be no better than he would be in equilibrium with the roles reversed"[4]. From Lemma 1 we have that the PBE wage outcome in country A, $w^{\alpha}_{s,A}(\underline{\beta};\overline{\beta})$, satisfies the following inequalities:

$$\overline{w} + \frac{r^P_f}{(r^I_u + r^P_f)}\left[\frac{(1-\overline{w})}{2}\frac{(3r^I_u + 2r^P_f)}{(r^I_u + r^P_f)} - 2tk\right] \cdot w^{\alpha}_{s,A}(\underline{\beta};\overline{\beta}) \cdot \tag{3}$$

$$\overline{w} + \frac{r^I_f}{(r^P_u + r^I_f)}\left[\frac{(1-\overline{w})}{2}\frac{(3r^P_u + 2r^I_f)}{(r^P_u + r^I_f)} - 2tk\right].$$

Notice that each wage satisfying these bounds can be the outcome by choosing appropriately the distribution over types. The lower (upper) bound is the wage outcome of the complete information game, when it is common knowledge that the union's type is r^I_u (r^P_u) and the firm's type is r^P_f (r^I_f) (and the union bargaining power is $\underline{\beta}$ ($\overline{\beta}$)). Expression (3) implies bounds on the firm's employment level, as well as on the firm's output, at equilibrium. In case of country B, the PBE wage outcome, $w^{\alpha}_{s,B}(\underline{\beta};\overline{\beta})$, will also satisfy such inequalities:

$$\overline{w} + \frac{r^P_f}{(r^I_u + r^P_f)}\left[\frac{(1-\overline{w})}{2}\frac{(3r^I_u + 2r^P_f)}{(r^I_u + r^P_f)} - 2t(1-k)\right] \cdot w^{\alpha}_{s,B}(\underline{\beta};\overline{\beta}) \cdot \tag{4}$$

$$\overline{w} + \frac{r^I_f}{(r^P_u + r^I_f)}\left[\frac{(1-\overline{w})}{2}\frac{(3r^P_u + 2r^I_f)}{(r^P_u + r^I_f)} - 2t(1-k)\right].$$

Lemma 1 and Expressions (3) and (4) also tell us that inefficient outcomes are possible, even as the period length shrinks to zero. The wage bargaining game may involve delay (strikes or lock-outs), but not perpetual disagreement, at equilibrium. Indeed, Watson (1998) has constructed a bound on delay in equilibrium which shows that an agreement is reached in finite time and that delay time equals zero as incomplete information vanishes.

In the literature on strikes, three different measures of strike activity are usually proposed: the strike incidence, the strike duration, and the number of work days lost due to work stoppages. See e.g. Cheung and Davidson (1991), Kennan and Wilson (1989). Since

compute because they correspond to the SPE payoffs of two bargaining games of complete information. These two games are defined by matching one player's most impatient type with the opponent's most patient type.

[4] Lemma 1 is not a direct corollary to Watson (1998) Theorem 1 because Watson's work focuses on linear preferences, but the analysis can be modified to handle the present case. Translating Watson (1998) Theorem 2 to our framework completes the characterization of the PBE payoffs. For any $\theta \in [U^{\alpha}_{s,\theta}(\underline{\beta}); U^{\alpha}_{s,\theta}(\overline{\beta})]$, $\phi \in [\Pi^{\alpha}_{s,\theta}(\overline{\beta}); \Pi^{\alpha}_{s,\theta}(\underline{\beta})]$, there exists distributions p_u and p_f, and a PBE such that the PBE payoffs are θ and ϕ. In other words, whether or not all payoffs within the intervals given in Lemma 1 are possible depends on the distributions over types. See also Vannetelbosch (1997).

we allow for general distributions over types and we may encounter a multiplicity of PBE, we are unable to compute measures of strike activity as the ones just mentioned. Indeed, in order to compute an expected strike duration one would need to fix some parameters of the model such as the distribution over types but it would imply a substantial loss of generality. So, we propose to identify the strike activity (strikes or lock-outs) with the maximal delay in reaching a wage agreement. Following Watson (1998) Theorem 3, the larger is the difference between the upper bound and lower bound on the bargaining outcome, the larger is the potential delay for obtaining an agreement. Therefore, the strike activity is given by the difference between the upper bound and the lower bound on the wage outcome. Our measure of strike activity gives the scope each player has for screening his opponent by making wage proposals satisfying the expressions (3) or (4), and hence, for delaying the wage agreement. Only in average this measure is a good proxy of actual strike activity.

When product markets are separated, the strike activity in country A is given by the following expression.

$$
\begin{aligned}
a_{s,A} &= \frac{\bar{\theta} - \underline{\theta}}{2}\left[(1-\bar{w})\left(3 - (\bar{\theta}+\underline{\theta})\right) - 4tk\right] \qquad (5)\\
&= \left(\frac{r_f^I r_u^I - r_f^P r_u^P}{r_f^P + r_u^I}\,;\,\frac{r_f^I r_u^I - r_f^P r_u^P}{r_f^I + r_u^P}\right)\left[\frac{(1-\bar{w})}{2}\left(\frac{r_u^I}{r_u^I + r_f^P} + \frac{2r_u^P + r_f^I}{r_u^P + r_f^I}\right) - 2tk\right].
\end{aligned}
$$

The strike activity in country B, $a_{s,B}$, is also given by expression (5) with k replaced by $1-k$. Notice that, if $k = \frac{1}{2}$, the strike activity is the same in both countries. Therefore, both $a_{s,A}$ and $a_{s,B}$ are increasing (decreasing) functions of r_u^I (r_u^P), are decreasing (increasing) functions of r_f^P (r_f^I), and are decreasing with the reservation wage $\bar{w}$, with the transportation cost t, and with their own market or country size.[5]

Proposition 1 *In the case of two separated product markets, the strike activity is decreasing with the country or market size and is greater in the country or market of smaller size.*

The explanation behind this result is the following one. Comparing first the PBE wage outcomes, we observe that

$$
w_{s,A}^{*}(\underline{\theta},\bar{\theta}) > w_{s,B}^{*}(\underline{\theta},\bar{\theta}) \text{ if } t > \frac{(1-\bar{w})(\bar{\theta}-\underline{\theta})(3-(\bar{\theta}+\underline{\theta}))}{4(\bar{\theta}(1-k)-\underline{\theta}k)}.
$$

If $k > \frac{1}{2}$, it is more likely for values of $\bar{\theta}$ and $\underline{\theta}$ that the above condition will be satisfied. So, country A will tend to enjoy a greater employment level and wage level than country

[5] However, the strike activity does not depend on the country or market size when the size is not a binding restriction. See the Appendix.

B. Therefore, it will be more easy for the firm to screen the union's type, and so the union of country A will concede more rapidly during the wage negotiation. As a result, strike activity in country A will be smaller.

4 An Integrated Product Market

Now, we consider the situation in which product markets open up for competition and both firms compete in prices in the integrated product market. As before, we assume that, in each country, the firm and the union negotiate wages as in Rubinstein's (1982) alternating-offer bargaining model. The two negotiations take place simultaneously and separately. That is, when negotiating the country wage level, the union and the firm of each country take the wage settlement of the other country as given. Moreover, in both countries the union and the firm always correctly anticipate the effect of wages on the subsequent price competition.

Under complete information, the country-level equilibrium wages are given by

$$\begin{cases} w_{c,A}^{SPE} = \arg\max [U_A]^{\beta} [\pi_A]^{1-\beta} \\ w_{c,B}^{SPE} = \arg\max [U_B]^{\beta} [\pi_B]^{1-\beta} \end{cases}$$

where β is still the union's bargaining power and it is given by expression $\frac{r_f}{r_u + r_f}$, and where the lowerscript "c" means that product markets are integrated in a common market and wage bargaining is made separately (but not independently) in each country (since the outcome of the bargaining in one country may depend on the outcome of the bargaining in the other country, and vice versa). Simple computations give us

$$\begin{aligned} w_c^{SPE} &= \overline{w} + \frac{3\beta}{2-\beta} t = w_{c,A}^{SPE} = w_{c,B}^{SPE} \\ &= \overline{w} + \frac{3 r_f}{2 r_u + r_f} t. \end{aligned} \tag{6}$$

Expression (6) tells us that, in complete information, the wage outcome when markets are integrated is still increasing with the reservation wage $\overline{w}$ and with the union bargaining power β. But now, contrary to the case with separated product markets, the wage outcome is increasing with the transportation cost t. One explanation follows. A marginal increase in product market integration, modelled as a decrease in transportion (or trade) costs, increases the degree of competition (decreases prices) without changing labour demands. As a result, the profits of the firm and the negotiated wage decrease.[6]

[6] Our result contrasts with Naybr (1998) who has shown that a decrease in t results in a higher labour demand. Then, the monopolistic unions exploit the higher labour demand to obtain higher wages.

Knowing the wage levels, one can easily obtain the equilibrium employment levels as well as the union and the firm equilibrium payoffs, which are given by

$$U^{*}_{c,A}(\theta) = U^{*}_{c,B}(\theta) = U^{*}_{c}(\theta) = \frac{3\theta}{2(2-\theta)}t,$$
$$\Pi^{*}_{c,A}(\theta) = \Pi^{*}_{c,B}(\theta) = \Pi^{*}_{c}(\theta) = \frac{t}{2}.$$

Thus, contrary to the case of separated markets, the union and the firm equilibrium payoffs are increasing with the transportation cost t. Not very surprisingly, the union equilibrium payoff is also increasing with the union bargaining power. Finally, the equilibrium employment level in both firms is the same and equal to $\frac{1}{2} = x^{*}_{A} = x^{*}_{B}$. This is due to the fact that, once product markets open up for competition, both firms are symmetric ones.

For the complete information situation, we compare now the equilibrium outcomes obtained under integrated product markets with the ones obtained for the case of two separated markets. We get that

$$w^{SPE}_{c,A} > w^{SPE}_{s,A} \text{ if and only if } t > \frac{(2-\theta)(1-\overline{w})(3-\theta)}{2(3+k(4-2\theta))},$$
$$w^{SPE}_{c,B} > w^{SPE}_{s,B} \text{ if and only if } t > \frac{(2-\theta)(1-\overline{w})(3-\theta)}{2(3+(1-k)(4-2\theta))}.$$

So, the factors which increase the likelihood that product market integration will increase the equilibrium wage of a country are : a big home market, strong unions, and high reservation wages.

Proposition 2 The greater the initial market size of a country, the union bargaining power, and the reservation wage are, the more likely the country's wage will increase when markets open up for competition.

Remember that we are considering the case where a monopolist would like to cover the entire integrated market. That is, we have assumed that the transportation cost is not too large :

$$t \leq \frac{(2-\theta)(1-\overline{w})}{4}.$$

Comparing this condition on t with the two conditions here above, we get

$$\frac{(2-\theta)(1-\overline{w})}{4} > \frac{(2-\theta)(1-\overline{w})(3-\theta)}{2(3+k(4-2\theta))} \text{ if and only if } k > \frac{3-2\theta}{4-2\theta},$$

and

$$\frac{(2-\theta)(1-\overline{w})}{4} > \frac{(2-\theta)(1-\overline{w})(3-\theta)}{2(3+(1-k)(4-2\theta))} \text{ if and only if } (1-k) > \frac{3-2\theta}{4-2\theta}.$$

Thus, in order to guarantee that it could exist a transportation cost t such that, for any $\alpha \in (0,1)$,

$$\frac{(2-\alpha)(1-\gamma w)}{4} > t > \frac{(2-\alpha)(1-\gamma w)(3-\alpha)}{2(3+k(4-2\alpha))} \text{ and/or}$$
$$\frac{(2-\alpha)(1-\gamma w)}{4} > t > \frac{(2-\alpha)(1-\gamma w)(3-\alpha)}{2(3+(1-k)(4-2\alpha))},$$

it is necessary that k is greater than $\frac{3}{4}$ or is smaller than $\frac{1}{4}$. For example, if $k > 3/4$, market integration could increase the equilibrium wage outcome in country A but then it would decrease the equilibrium wage outcome in country B.[7] That is, if the market sizes of both countries are different enough, then market integration increases (reduces) the wage outcome in the country with the greatest (the smallest) market size while reducing (increasing) output and employment in that country.

In fact, when both firms compete in the integrated product market, wage spillover effects are present. These spillover effects tends to lower wages but are decreasing with the transportation cost and with the country market size. As a consequence, in stage one of the game, the firm (and the union) of the country with the smallest market size has a greater incentive to commit to a low wage in order to obtain a larger market share in stage two, than the firm (and the union) of the country with the greatest market size. On the contrary, the union of the country with the greatest market size may be tempted to obtain an increase of the negotiated wage that would compensate the anticipated reduction in employment and output level due to the integration of both product markets.

We consider now the country-level wage bargaining with private information about the discount rates. Once product markets are integrated, both firms are symmetric ones. Hence, we look for symmetric PBE.

Lemma 2 (Integrated markets) Consider the country-level wage negotiations with incomplete information in which the distributions p_f and p_u are common knowledge, and in which the period length shrinks to zero. Assume that inside each country the union and the firm take the wage settlement in the other country as given during the bargaining. Then, for any symmetric perfect Bayesian equilibria (PBE), the payoff of the union in each country belongs to $[U_c^*(\underline{\alpha}); U_c^*(\overline{\alpha})]$ and the payoff of the firm in each country belongs to $[\Pi_c^*(\overline{\alpha}); \Pi_c^*(\underline{\alpha})]$.

[7] Notice that if $k = 1/2$ then the above conditions are never satisfied whatever the union bargaining power. Therefore, if the initial market sizes of both countries are identical, then market integration decreases the equilibrium wages, leaving unchanged the output and employment levels of both countries. This result is similar to the one obtained by Dowrick (1989), Huizinga (1993) and Sorensen (1993) who showed that product market integration may give rise to lower wages due to an increase in the degree of competition.

Lemma 2 is the counterpart of Lemma 1 for the country-level wage negotiations when product markets are integrated. Following Lemma 2 and the complete information results we are able to state some properties about the country-level wage outcomes. The symmetric PBE wage outcome $w_c^{\alpha}(\underline{\theta},\theta)$ will satisfy the following inequalities:

$$\overline{w} + \frac{3\,r_f^P}{2\,r_u^I + r_f^P}t \;\cdot\; w_c^{\alpha}(\underline{\theta},\theta) \;\cdot\; \overline{w} + \frac{3\,r_f^I}{2\,r_u^P + r_f^I}t. \tag{7}$$

Notice that each wage satisfying these bounds can be the outcome by choosing appropriately the distribution over types. The lower (upper) bound is the wage outcome of the complete information game, when it is common knowledge that the union's type is r_u^I (r_u^P) and the firm's type is r_f^P (r_f^I) (and the union bargaining power is $\underline{\theta}$ (θ)).

A sufficient condition such that, with private information about the discount rates, market integration will increase the wage in country A is

$$w_c^{\alpha}(\underline{\theta},\theta) > w_{S,A}^{\alpha}(\underline{\theta},\theta) \text{ if } t > \frac{\theta(2-\underline{\theta})(1-\overline{w})(3-\theta)}{2(3\underline{\theta}+k\theta(4-2\underline{\theta}))}.$$

Similarly, a sufficient condition such that, with private information about the discount rates, market integration will increase the wage in country B is

$$w_c^{\alpha}(\underline{\theta},\theta) > w_{S,B}^{\alpha}(\underline{\theta},\theta) \text{ if } t > \frac{\theta(2-\underline{\theta})(1-\overline{w})(3-\theta)}{2(3\underline{\theta}+(1-k)\theta(4-2\underline{\theta}))}.$$

Notice that, if $\theta = \underline{\theta} = \theta$ then these two conditions coincide with the ones under complete information. Thus, if k is greater than $\frac{3}{4}$ or smaller than $\frac{1}{4}$ and the amount of private information $|\theta - \underline{\theta}|$ is small enough, it is very likely that we recover the results obtained under complete information. Hence, if the transportation cost t satisfies the inequalities (8), then market integration will increase for sure the wage level in country A. Similarly, if the transportation cost t satisfies the inequalities (9), then market integration will increase for sure the wage level in country B.

$$\frac{(2-\theta)(1-\overline{w})}{4} > t > \frac{\theta(2-\underline{\theta})(1-\overline{w})(3-\theta)}{2(3\underline{\theta}+k\theta(4-2\underline{\theta}))}, \tag{8}$$

$$\frac{(2-\theta)(1-\overline{w})}{4} > t > \frac{\theta(2-\underline{\theta})(1-\overline{w})(3-\theta)}{2(3\underline{\theta}+(1-k)\theta(4-2\underline{\theta}))}. \tag{9}$$

In case of integrated product markets, the strike activity in both countries is given by the following expression.

$$a_c = \frac{6(\theta-\underline{\theta})t}{(2-\theta)(2-\underline{\theta})} = \frac{6(r_f^I r_u^I - r_f^P r_u^P)t}{(2r_u^P + r_f^I)(2r_u^I + r_f^P)}. \tag{10}$$

Similarly to the case of separated product markets, we observe that a_c is increasing (decreasing) with r_u^I (r_u^P), and decreasing (increasing) with r_f^P (r_f^I). But now, the strike

activity is increasing with the transportation cost t. The intuition behind this result has to do with the competition on the product market. As mentioned before, when product markets are integrated, each union-firm pair expects to be able to alter its relative wage position in the integrated industry. Therefore, it results wage spillover effects: each union-firm pair has an incentive to lower wages in order to increase its output level and the firm profits, and to gain a larger share of the integrated product market. This incentive is stronger the smaller the transportation costs are. Indeed, a marginal increase in product market integration modelled as a decrease in transportation costs increases the competition between firms. This explain why it is likely that more concessions and less conflicts in wage negotiations will occur when transportation cost decrease.

Proposition 3 *In the case of integrated product markets, a marginal increase in product market integration modelled as a decrease in the transportation cost will reduce the strike activity in both countries.*

Now we compare the strike activity when product markets are integrated with the strike activity when product markets are separated. That is, we compare Expression (5) with Expression (10). For country A, this comparison leads to the following result:

$$a_c < a_{s,A} \text{ if and only if } t < \frac{(1-w)(3-(\theta+\underline{\theta}))(2-\theta)(2-\underline{\theta})}{4(3+k(2-\theta)(2-\underline{\theta}))}.$$

For country B, this comparison leads to:

$$a_c < a_{s,B} \text{ if and only if } t < \frac{(1-w)(3-(\theta+\underline{\theta}))(2-\theta)(2-\underline{\theta})}{4(3+(1-k)(2-\theta)(2-\underline{\theta}))}).$$

Notice that the conditions on t coincide whenever both countries have the same market size. From these conditions we are able to draw the following result.

Proposition 4 *The more amount of private information the firm and the union have and the smaller the transportation cost is, the more likely the strike activity will decrease when markets open up for competition.*

This result might corroborate some empirical observations about the European market integration. In 1985 both Spain and Portugal (as well as Greece) joined the European Community. One of their main competitor is France. We observe that, before the market opened up the average number of strikes and lock-outs was 2885 for France, 1861 for Spain, and 437 for Portugal. But, after the market opened up, the average number of strikes and lock-outs drops quite significatively to 1663 for France, 1153 for Spain, and 280 for Portugal (Sources: ILO Yearbook. Data on strikes and lock-outs from 1976 until 1999). Moreover, the number of strikes has still decreased during the last decade due to

gradually more integration which is modelled by a decrease of the transportation cost t in our model (see Proposition 3).

However, it is not excluded that, the strike activity might increase in one country and decrease in the other country when markets open up for competition. One can check that, if $w_c^{\alpha}(\underline{\theta};\theta) > w_{s,A}^{\alpha}(\underline{\theta};\theta)$ then $a_c > a_{s,A}$, and if $w_c^{\alpha}(\underline{\theta};\theta) > w_{s,B}^{\alpha}(\underline{\theta};\theta)$ then $a_c > a_{s,B}$. Take the case where country A has a home market size greater than $\frac{3}{4}$. Assume that the private information $\theta - \underline{\theta}$ is small enough to guarantee that $w_c^{\alpha}(\underline{\theta};\theta) > w_{s,A}^{\alpha}(\underline{\theta};\theta)$ and $w_c^{\alpha}(\underline{\theta};\theta) < w_{s,B}^{\alpha}(\underline{\theta};\theta)$. Then, from Proposition 1 and the results here above, we have $a_{s,A} < a_c$ and $a_{s,A} < a_{s,B}$. So, we do not know whether a_c is smaller or greater than $a_{s,B}$. But, if it is commonly known that the union is stronger than the firm (i.e. $\underline{\theta} \geq 0.5$) and the amount of private information $\theta - \underline{\theta}$ is small enough, then the strike activity of the country with the smallest market size will decrease when markets open up for competition. The intuition behind this result follows. When separated product markets open up for competition, the biggest (the smallest) country will loose (gain) a substantial market share. As a consequence, the union of the biggest (the smallest) country will behave more aggressively (less aggressively) in wage negotiations in order to get a higher wage that compensates the anticipated lost in employment. Therefore, more (less) strike activity would result in the biggest (smallest) country.

Proposition 5 *If it is commonly known that the union is stronger than the firm and the private information is small enough, then the strike activity of the country with the smallest (greatest) market size will decrease (increase) when separated product markets open up for competition.*

5 Conclusion

Within an incomplete information framework, we have developed a spatial two-country model with imperfectly competitive product markets and unionized labor markets. Two firms located on former segmented product markets start to compete at the same enlarged product market. We have investigated the effects of product market integration on the negotiated wage and the strike activity. When product markets are segmented, both the wage outcome and the strike activity in each country decrease with the transportation cost and the market size. However, when product markets are integrated, wages and strikes increase with the transportation cost which is interpreted as the degree of integration.

Contrary to the results found in the literature, we have shown that, under the complete information framework, a reduction in fixed costs (that makes product markets opening up for competition) has an ambiguous impact on the negotiated wage. So, our model

suggests that, even with complete information, one should be cautious when making policy recommendations with respect to the impact of product market integration on wages and employment levels.

Nevertheless, this ambiguity did not prevent us to draw very interesting results once private information is introduced. Indeed, we have shown that, the greater the initial market size of a country, the stronger the union and the higher the reservation wage are, the more likely the country's wage will increase when markets open up for competition. With respect to the strike activity we get : the more amount of private information the firm and the union have and the smaller the transportation cost is, the more likely the strike activity will decrease when markets open up for competition.

The related literature has modelled the wage negotiation using the monopoly union model, where in fact the union chooses the wage which maximize its utility. See Naylor (1998), Munch and Sorensen (2000). Here, we have used the more general right-to-manage model, where the union and the firm really negotiate the wage and we have shown that the results obtained with a monopoly union are not robust to this generalization.

We have also assumed that firms are exogenously located at the extreme points of the unit interval. One could analyze the issue of location by using the Hotelling interval with quadratic transportation costs. See d'Aspremont et al. (1979). Each firm then has the possibility to reduce the degree of horizontal differentiation by moving towards the center of its incumbent market. This would maximize the profits when product markets are segmented as the monopolist could extract more surplus from its consumers. The decrease in horizontal differentiation however increases price competition once product markets are integrated. The revenues from selling to new consumers therefore decrease. This reflects the principle of maximal differentiation. Therefore, the assumption we made of positioning firms at the two opposite extremes offers the highest scope for profitable entry in the other product market.

There are a number of potential directions for further work. First, the paper has focussed on the case of former monopolistic product markets with identical technologies and transportation costs. It would be interesting to consider various initial differences across the product markets, such as in market structure, technologies and transportation costs. Second, we have restricted our analysis to the case of fixed firms' locations. Since the market can be supplied by firms from anywhere within the integrated market, it becomes less important where firms locate. Firms could move to areas with low production costs, leaving high cost areas. Driffill and Ploeg (1995) showed that wages decrease if unions take this into account. A complete analysis of this situation, as well as empirical studies, is left for further research.

6 Appendix

Solving the case of separated markets when the countries market sizes are not binding restrictions, we obtain under complete information the following results :

$$w^{SPBE}_{s,A} = \overline{w} + \frac{\theta}{2}(1-\overline{w}) = \overline{w} + \frac{r_f(1-\overline{w})}{2(r_u + r_f)},$$

$$w^{SPBE}_{s,B} = \overline{w} + \frac{\theta}{2}(1-\overline{w}) = \overline{w} + \frac{r_f(1-\overline{w})}{2(r_u + r_f)},$$

$$U^{*}_{s,A}(\theta) = \frac{\theta(2-\theta)}{8t}(1-\overline{w})^2,$$

$$I^{*}_{s,A}(\theta) = \frac{(1-\frac{\theta}{2}(1-\overline{w})-\overline{w})^2}{4t},$$

$$U^{*}_{s,B}(\theta) = \frac{\theta(2-\theta)}{8t}(1-\overline{w})^2,$$

$$I^{*}_{s,B}(\theta) = \frac{(1-\frac{\theta}{2}(1-\overline{w})-\overline{w})^2}{4t}.$$

In the private information framework, the PBE wage outcomes will satisfy the following inequalities :

$$\overline{w} + \frac{r^P_f(1-\overline{w})}{2(r^I_u + r^P_f)} \cdot w^{*}_{s,A}(\underline{\theta};\overline{\theta}) \cdot \overline{w} + \frac{r^I_f(1-\overline{w})}{2(r^P_u + r^I_f)},$$

$$\overline{w} + \frac{r^P_f(1-\overline{w})}{2(r^I_u + r^P_f)} \cdot w^{*}_{s,B}(\underline{\theta};\overline{\theta}) \cdot \overline{w} + \frac{r^I_f(1-\overline{w})}{2(r^P_u + r^I_f)},$$

and the strike activity is given by :

$$a_{s,A} = \frac{\overline{\theta}-\underline{\theta}}{2}(1-\overline{w}) = \frac{\left[r^I_f r^I_u - r^P_f r^P_u\right]}{2\left(r^P_f + r^I_u\right)\left(r^I_f + r^P_u\right)}(1-\overline{w}) = a_{s,B}.$$

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