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Unionization Structures in International Oligopoly*

Beatrice Pagel[†] Christian Wey[‡]

February 2012 (first version: October 2010)

Abstract

We examine how competition in international markets affects a union's choice of wage regime which can be either uniform or discriminatory. Firms are heterogenous with regard to international competition. When unions choose their wage regimes sequentially, a discriminatory outcome becomes more likely when international competition increases. However, for intermediate levels a union may stick with a uniform wage regime even if the rival union adopts a discriminatory regime. When competition is sufficiently intense, both unions revert to the discriminatory regime. Paradoxically only in those latter instances all parties (consumers, workers and firms) may be better off (each in aggregate) if all unions adopt a uniform wage regime. We conclude that union incentives to coordinate their wage regimes should then also become largest.

JEL-Classification: D43, J51, L13.

Keywords: Unionization, International Oligopoly, Uniform Wages.

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1 Introduction

As globalization and economic integration have increased the competitive pressure in international product markets, the impact of this trend on labor market organization has become increasingly important. While there have been repeated demands for more wage flexibility in response to increasing demand (and supply-) side pressure (see OECD 1996, 2006), empirical evidence on the development of labor market institutions towards more decentralized wage bargaining structures is mixed.¹

For some countries, such as Denmark and Sweden, there has been a clear tendency towards more decentralization, other countries (e.g., Belgium and Italy) have witnessed a higher degree of centralization in wage bargaining since the 1980s than at any other time in the postwar period (Wallerstein and Western 2000). In a comparative study of 17 OECD countries, Santoni (2009) shows that market integration has impacted negatively on the level of wage bargaining. Similarly, in Germany West (East) the percentage of employment contracts governed by centralized wage settlements has fallen from 70% (56%) in 1996 to 56% (38%) percent in 2009.²

The relation between market integration and trade costs on the one hand, and union power on the other hand has received considerable attention in the literature (e.g., Brander and Spencer 1988; Mezzetti and Dinopoulos 1991; Huizinga 1993; Munch and Skaksen 2002). However, in most models the degree of wage bargaining centralization is assumed to be exogenously given (Driffill and van der Ploeg 1993, 1995; Naylor 1999).³ In contrast, we endogenize the choice of wage-setting regimes by labor unions. Another critical departure from previous works is that we consider heterogeneous firms which are active in different

¹We follow Calmfors and Driffill (1988), Moene and Wallerstein (1997), Flanagan (1999), and Wallerstein (1999) to differentiate national unionization structures according to the degree of wage setting centralization. Under a decentralized structure wages are set between a single employer and the union while the union negotiates a uniform wage for the entire industry under a centralized system.

²IAB Betriebspanel: "http://doku.iab.de/aktuell/2010/Tarifbindungsentwicklung_1996-2009.pdf".

³An exception is Petrakis and Vlassis (2004) who analyze endogenous wage institutions at the national level without considering international competition.

market environments.

The diversity of wage-setting institutions and their effects in internationally integrated product markets is analyzed in Corneo (1995). That paper examines the impact of different bargaining regimes when product markets are perfectly integrated. Besides other things, it is shown that wages tend to be higher under a centralized bargaining structure when compared with decentralized bargaining. Moreover, this tendency becomes more pronounced when countries' sizes (in terms of national firms) become more asymmetric.

The effects of different labor market structures (varying in the degree of centralization) on product market competition and market performance have been analyzed in many works. One robust finding is that the uniformity rule under a centralized union structure can unfold beneficial effects for firms' incentives to innovate or to set up new production facilities (see Agell and Lommerud 1993; Leahy and Montagna 2000; Haucap and Wey 2004).⁴ Centralized wage-setting constrains the unions' ability to extract rents from firms which can be beneficial for firms and unions alike as it reduces hold-up problems associated with union power.

Our paper analyzes a two-country model where national firms operate in different markets which gives rise to firm-specific labor demands. We analyze the incentives of labor unions to choose uniform or discriminatory wage-setting regimes in the presence of international competition. On the one hand unions might prefer discriminatory wages (which represents the adjustment of unionization structures to firm-specific conditions) in order to extract rents optimally from firms enjoying different degrees of monopoly power. On the other hand a uniform wage regime exhibits a commitment value when there is international competition: if the effect of a uniform wage is to raise the wage above the discriminatory level in the international market, labor unions can benefit from a "competition dampening" effect.⁵ Both a fully centralized or a partially centralized outcome can emerge in equilibrium whenever international competition is not too strong. In the

⁴See also Mukherjee and Pennings (2011) who qualify that assertion by considering licensing.

⁵A similar effect can occur in final goods markets when a retail chain adopts a uniform pricing policy (see Dobson and Waterson 2008).

parlance of industrial organization a union choosing a uniform wage regime adopts a “fat cat” strategy by committing to raise the wage level of the international firm (Fudenberg and Tirole 1984). As unions compete indirectly in wages (via the international firms) a uniform wage regime in country 1 induces a higher wage demand of the rival union in country 2 because of strategic complementarity. The latter reaction is independent of country 2’s wage regime so that an asymmetric outcome is possible where one country adopts a centralized regime with uniform wages and the other country a decentralized regime with wage flexibility at the firm level.

Interestingly, a fully decentralized outcome emerges when international competition becomes very intense. In those instances, we identify the possibility of a Pareto improvement through international cooperation of unions’ wage regime choices. That is, when international competition is very intense, then each set of agents (i.e., unions, firms and consumers) benefits from a cooperative move towards uniform wage regimes. We, therefore, expect that international coordination of (national) wage setting regimes should become more likely (and political feasible) when market integration further deepens.

Our paper proceeds as follows. In Section 2 we present an international oligopoly model with two national and two international firms. We characterize the equilibria under different international unionization structures. Section 3 compares wage levels and firm profits under three possible international unionization structures. Here, we also characterize the possibility of a Pareto improvement through international union cooperation. In Section 4 we solve for the equilibrium wage regime and we show that all international unionization structures may emerge depending on the intensity of competition in the international market. Finally, Section 5 concludes.

2 The Model

We consider a two-country model with two (heterogeneous) firms in each country. All firms employ the same type of labor and they are active in different market environments. We suppose that markets differ concerning their competitive intensity. There are three

separate markets: two national markets and a single international market. The national market in each country, $i = 1, 2$, is served by a firm N_i , with $i = 1, 2$. We suppose that each national market is only served by a single domestic firm; in particular, there is no international competition in the national market.⁶ The (linear) demand in country i 's national market is given by $q_{N_i}(p_{N_i}) = 1 - p_{N_i}$, for $i = 1, 2$, where p_{N_i} is the price charged by N_i .

In the international market two firms I_1 and I_2 produce horizontally differentiated products and compete à la Hotelling. Firm I_i is located in country i . The two firms face a unit mass of consumers who are assumed to be uniformly distributed along the unit line segment $[0, 1]$. We assume that firms are located at the ends of the Hotelling line. Consumers face transportation cost $t > 0$, which is assumed to be linear in the distance between a consumer's location on the line and the location of a firm. Transportation costs measure the intensity of competition between the firms. The lower t the higher the degree of competition in the international market.

The utility of a consumer located at location x and buying a product at price p_{I_i} from a firm located at x_i is given by $V(x, t, x_i, p_{I_i}) = \vartheta - p_{I_i} - t|x - x_i|$, where x_i is equal to 0 (1) if the consumer buys from international firm I_1 (I_2). The parameter ϑ denotes the constant valuation of a consumer for the purchased product. We assume that ϑ is sufficiently high, so that the market is always covered in equilibrium. It is straightforward to determine the demand faced by firm I_i by identifying the indifferent consumer $\bar{x} = (p_{I_2} - p_{I_1} + t)/(2t)$ from which we get the demand of firm I_1 and the demand of firm I_2 as $q_{I_1} = \bar{x}$ and $q_{I_2} = 1 - \bar{x}$, respectively.

Firms operate under a constant returns to scale technology with respect to labor, which is the only variable input for both national and international firms. Without loss of generality, we assume that $q_{k_i} = l_{k_i}$, for $i = 1, 2$ and $k = N, I$ where q_{k_i} is the output and l_{k_i} employment of firm i in market k .

⁶Our results do not depend on our assumption that the national market is served by only a single firm. What is crucial for our results is that the competitive intensity differs in the national and the international market.

The workforce in each country is represented by a national labor union, union 1 and union 2, which are responsible for wage setting in their respective countries. We apply the right-to-manage approach which stipulates that a labor union sets the wage rate by making a take-it or leave-it offer to the firms. For given (and observable) wage rates, firms then determine their employment levels. We assume that each union maximizes its wage bill.

The game proceeds as follows. In stage 1*a*, the union located in country 1 chooses its wage regime. It can decide whether it wants to set discriminatory (*D*) or uniform (*U*) wages for the two firms in its country. Observing this choice, the union in country 2 determines its wage regime in stage 1*b*. In stage 2, the labor unions simultaneously set their wage rates. Finally, in stage 3, firms observe wage rates, and set prices for their products. We solve the game by backward induction to derive subgame perfect Nash equilibria.

Given that there are two rival unions who can determine their wage-setting regimes, we have to consider three possible international unionization structures:

1. *International Discriminatory (DD)*: Labor unions in both countries choose discriminatory wage-setting regimes.
2. *International Uniform (UU)*: Labor unions in both countries choose uniform wage-setting regimes.
3. *International Asymmetric (DU) or (UD)*: The final international unionization structure is asymmetric. One union chooses a discriminatory wage-setting regime, while the rival union decides to apply a uniform regime.

We solve the model proceeding by backward induction for all three international unionization structures. In the last stage of the game, firms set prices. National firms have local monopoly positions in their markets. The profit function of a national firm is given by

$$\Pi_{Ni} = (1 - p_{Ni})(p_{Ni} - w_{Ni}), \text{ for } i = 1, 2,$$

where w_{N_i} is the wage rate paid by national firm i to each employed worker. Solving the first order conditions $\partial \Pi_{N_i} / \partial p_{N_i} = 0$ yields the optimal price choices and the associated quantities in stage 3

$$\begin{aligned}\hat{p}_{N_i} &= \frac{1 + w_{N_i}}{2}, \\ \hat{q}_{N_i} &= \frac{1 - w_{N_i}}{2}.\end{aligned}\tag{1}$$

Simultaneously, the international firms compete in prices. The profit function of firm I_i is given by

$$\Pi_{I_i} = (p_{I_i} - w_{I_i}) q_{I_i}, \text{ for } i = 1, 2,$$

where w_{I_i} is the wage rate paid by firm I_i to its employees. Solving the first order conditions $\partial \Pi_{I_i} / \partial p_{I_i} = 0$ for $i = 1, 2$ yields the optimal prices and quantities

$$\begin{aligned}\hat{p}_{I_i} &= \frac{3t + 2w_{I_i} + w_{I_j}}{3}, \\ \hat{q}_{I_i} &= \frac{3t - w_{I_i} + w_{I_j}}{6t},\end{aligned}\tag{2}$$

with $i \neq j$. In stage 2 unions set wages for the workforce they represent in their respective countries. The objective of each union in country i is to maximize its wage bill given by

$$U_i = (w_{N_i} \hat{l}_{N_i}) + (w_{I_i} \hat{l}_{I_i}), \text{ for } i = 1, 2,$$

where the labor demands \hat{l}_{N_i} and \hat{l}_{I_i} follow from (1) and (2), respectively. According to the wage-setting regimes unions have determined in the first stage of the game, we have to consider the three international unionization structures DD , UU , and UD/DU separately.

International Discriminatory (DD). Assume that both unions have adopted discriminatory wage regimes. In this case, the optimal wage rates set by each union are given by the solution of

$$\{w_{N_i}^{DD*}, w_{I_i}^{DD*}\} = \arg \max_{w_{N_i}, w_{I_i}} U_i(w_{N_i}, w_{N_j}^{DD*}, w_{I_i}, w_{I_j}^{DD*}), \text{ for } i, j = 1, 2, i \neq j.$$

Using (1) and (2) and solving the respective first order conditions $\partial U_i(\cdot)/\partial w_{I_i} = 0$ and $\partial U_i(\cdot)/\partial w_{N_i} = 0$ for $i = 1, 2$ yields the following equilibrium wage rates charged to the national and the international firm, respectively:

$$w_N^{DD*} = \frac{1}{2} \text{ and } w_I^{DD*} = 3t.$$

Note that equilibrium wages are identical under scenario DD for $t = 1/6$. In this case, the unionization structure collapses to the case were both unions set uniform wages. Note that the wage charged to the international firm becomes larger than the wage of the national firm if international competition is relatively weak (i.e., $t > 1/6$ holds), while the opposite is true if competition is sufficiently strong (i.e., $t < 1/6$ holds).

International Uniform (UU). Consider that both unions have adopted uniform wage-setting regimes so that the outcome is an international uniform unionization structure. In this case, a uniform wage rate $w_{N_i} = w_{I_i} = \bar{w}_i$ is set by each union to maximize the total wage bill. The optimal wage rate each union sets is the solution to

$$\{\bar{w}_i^{UU*}\} = \arg \max_{w_i} U_i(w_i, \bar{w}_j^{UU*}), \text{ for } i, j = 1, 2, i \neq j.$$

Again, we solve the first order conditions $\partial U_i(\cdot)/\partial w_i = 0$ for $i = 1, 2$ using (1) and (2) to obtain the equilibrium wage rate each union sets; namely,

$$\bar{w}^{UU*} = \frac{6t}{1 + 6t}.$$

Obviously, national firms are now affected by the degree of competition in the international market. When international competition becomes more intense (i.e., t decreases), then the uniform wage level decreases for both the national and the international firm. Note that $w_N^{DD*} = w_I^{DD*} = \bar{w}^{UU*}$ is true at $t = 1/6$.

International Asymmetric (DU) or (UD). Finally, we analyze the case when one union has adopted a discriminatory wage regime while the other union chooses to set uniform wages. The timing of our game postulates that the union located in country 1 chooses its wage regime first, with the union located in country 2 following. Let

us assume at this point that union 1 adopts the discriminatory regime in an asymmetric outcome. Below in Section 4, we will show that whenever the asymmetric unionization structure is an equilibrium outcome, the union which determines its wage regime first will choose discrimination.

Given that union 1 has adopted a discriminatory regime in stage 1a, it sets discriminatory wages in stage 2 which solve

$$\{w_N^{DU*}, w_I^{DU*}\} = \arg \max_{w_{N_1}, w_{I_1}} U_1(w_{N_1}, w_{I_1}, \bar{w}_2^{DU*}).$$

When the final unionization structure is asymmetric, union 2 has obviously opted for a uniform wage regime in stage 1b. In stage 2, union 2 sets a uniform wage rate to maximize its wage bill which solves

$$\{\bar{w}^{DU*}\} = \arg \max_{\bar{w}_2} U_2(\bar{w}_2, w_N^{DU*}, w_I^{DU*}).$$

Solving the set of three first order conditions, the equilibrium wage rates set by unions 1 and 2 are

$$\begin{aligned} w_N^{DU*} &= \frac{1}{2}, \\ w_I^{DU*} &= \frac{t(4+6t)}{1+4t}, \text{ and} \\ \bar{w}^{DU*} &= \frac{5t}{1+4t}. \end{aligned}$$

Note that, in contrast to the previous international unionization structures, firms competing in the international market will now face different labor costs. Which international firm pays the higher wage rate and thus obtains a lower profit than its rival will depend on the intensity of competition in the international market.

We solve for the equilibrium profits, wage bills, prices and consumer surplus for the three unionization structures in the Appendix. Before we analyze the equilibrium choices of wage regimes of the labor unions, we can compare the effects of different forms of unionization structures on unions and firms.

3 The Impact of Unionization Structures on Wages and Profits

We begin with an analysis of the different international unionization structures. Having solved for the wage rates and profit levels of firms, we can compare them under the different structures. Therefore, we abstract from the labor unions choices of wage-setting regimes in stages 1a and 1b and treat them as given for the moment. To some extent, an exogenous determination of wage-setting regimes has been present in many European countries where wage bargaining between labor unions and firms has been institutionalized through labor market regulations and/or social norms. Institutional change, e.g., from an egalitarian wage system towards a more flexible, and hence, discriminatory wage regime comes not overnight but rather is the result of a transformation process which may take decades.⁷

3.1 Wages

The following Lemma summarizes the results of the comparison of wage levels.

Lemma 1. *The ranking of wage rates within different market structures depends on the intensity of competition in the international market and the prevailing unionization structures:*

i) If the intensity of competition in the international market is low, i.e., $t > 1/6$ holds, then $w_I^{DD} > w_I^{DU*} > \bar{w}^{DU*} > \bar{w}^{UU*} > w_N^{DD*} = w_N^{DU*}$.*

ii) If the intensity of competition in the international market is high, i.e., if $t < 1/6$ holds, then $w_N^{DD} = w_N^{DU*} > \bar{w}^{UU*} > \bar{w}^{DU*} > w_I^{DU*} > w_I^{DD*}$.*

⁷In Germany, the dominant industry unions of the *Deutsche Gewerkschaftsbund* (as, e.g., *IG Metall*) strictly opposed any form of wage flexibility for at least twenty years; a position which was eventually given up in the last decade of the last century when opting out and opening clauses became widely adopted elements of collective agreements (see Haucap, Pauly, and Wey 2007).

Moreover, equality holds with $w_I^{DD*} = w_I^{DU*} = \bar{w}^{DU*} = \bar{w}^{UU*} = w_N^{DD*} = w_N^{DU*}$ for $t = 1/6$.

The interpretation of Lemma 1 is straightforward. Independent of the degree of competition in the international market, the level of uniform wages (\bar{w}^{UU*} or \bar{w}^{DU*}) lies inbetween the discriminatory wage levels. This is the averaging effect of uniformity: each labor union optimally sets the uniform wage rate such that asymmetries between the firms are balanced.

In which market the highest (lowest) wage rates are paid by firms, depends on the intensity of competition between the international firms. For a low degree of competition, i.e., case *i*) holds, national firms pay the lowest (discriminatory) wages and international firms pay the highest wage rates.

This is the case because, from a labor union point of view, the international market is the ‘larger’ market when $t > 1/6$. Obviously, the (discriminatory) wage rates are directly related to competitive pressure in this market: $\partial w_I^{DD*}/\partial t > 0$ (likewise $\partial w_I^{DU*}/\partial t > 0$), i.e., the larger the market power of the international firms, the more rent a labor union can extract from the firms. For $t > 1/6$, the degree of international competition is sufficiently low so that the unions will set discriminatory wages in this market which exceed the wage levels paid by national firms.

Note that, while the discriminatory wage rates paid by national firms in structures *DD* and *DU* are identical, the same is not true for the wage rates of the international firms, as $w_I^{DD*} > w_I^{DU*}$. This is due to the asymmetry in wage levels structure *DU* implies. As wage regimes are determined by the labor unions before the actual wage rates are set, each union knows which kind of wage behavior its rival displays. In structure *DU*, the discriminating union knows that its rival sets a uniform wage, which must optimally be lower than a discriminatory wage because of the averaging effect described above. As a consequence, the discriminating union will set a wage $w_I^{DU*} < w_I^{DD*}$ because otherwise the international firm would lose too much of a market share vis-à-vis its competitor operating at lower wage costs.

For high intensity of competition in the international market, i.e., $t < 1/6$, the order of wage rates is reversed. From the point of view of a labor union, the international market is now the small market compared to the national market. Consequently, discriminatory wage rates paid by national firms will be highest, while those paid by the international firms in structure DD are lowest. The averaging effect of uniformity implies that levels of uniform wage rates (either in structure UU or DU) will be inbetween.

Note that the ordering of the two uniform wage rates is now reversed as well: $\bar{w}^{UU*} > \bar{w}^{DU*}$. In unionization structure DU , the uniform wage regime of union 2 now exhibits a *commitment effect*: a union setting the uniform wage in an asymmetric structure knows that it will put the firm paying \bar{w}^{DU*} at a disadvantage in product market competition because the averaging effect of uniformity will cause the wage rate paid by the international firm to increase compared to a discriminatory level. Consequently, firm I_2 will behave less aggressively in the international market.

Union 1 can partially free-ride on this effect: it can raise its discriminatory wage rate w_I^{DU*} above the purely discriminatory level, because wages are strategic complements for the labor unions, and firm I_1 will still capture more than half of the international market, because it can price more aggressively than its competitor due to lower input costs. Here, union 1 gains twice: first through an increase of the wage level charged to the international firm and second through a higher level of employment.

3.2 Profits

The comparison of profits shows that firms are not only affected by the wage regime of the union in their home country, but also by that of the foreign union through the link of product market competition.

Lemma 2. *The profit levels of firms depend on the intensity of competition in the international market and the prevailing unionization structures:*

i) If the intensity of competition in the international market is low, i.e., $t > 1/6$ holds, then the ordering of profits of the national firms and the international firms is given by

$\Pi_{N_1}^{DD*} = \Pi_N^{DU*} > \Pi_N^{UU*} > \Pi_{N_2}^{DU*}$ and $\Pi_{I_2}^{DU*} > \Pi_I^{UU*} = \Pi_I^{DD*} > \Pi_{I_2}^{DU*}$, respectively.

ii) If the intensity of competition in the international market is high, i.e., if $t < 1/6$ holds, then the ordering of profits of the national firms and the international firms is given by $\Pi_{N_2}^{DU} > \Pi_N^{UU*} > \Pi_N^{DD*} = \Pi_{N_1}^{DU*}$ and $\Pi_{I_1}^{DU*} > \Pi_I^{UU*} = \Pi_I^{DD*} > \Pi_{I_2}^{DU*}$, respectively.*

Moreover, equality holds with $\Pi_{N_1}^{DD*} = \Pi_N^{DU*} = \Pi_N^{UU*} = \Pi_{N_2}^{DU*}$ for $t = 1/6$.

The intuition behind Lemma 2 is straightforward and can be summarized as follows. From the above analysis we know that the international market is the “large” market from the point of view of labor unions, when $t > 1/6$. A uniform wage, therefore, lowers the wage rate paid by an international firm. As profits must be identical for symmetric unionization structures, an interesting point arises when the unionization structure is asymmetric.

For $t > 1/6$, national firms prefer discriminatory wages in their home country, as the averaging effect of uniformity would cause higher wage rates for them compared to a discriminatory level. Comparing the profits of a national firm in structures UU and DU when the firm pays a uniform wage, we find that a firm prefers international uniform unionization over an asymmetric structure. Although the national firm faces no international competition, its profits are lower when the foreign union adopts a discriminatory regime when in the home country a uniform wage regime is in place.

This is the case, because the uniform wage rate is higher in the asymmetric structure DU than when both unions choose a uniform regime. The discriminating union sets a high discriminatory wage in the international market, thereby dampening competition and giving an incentive for the rival union to set high uniform wage rate – to the detriment of the national firm.

In part *ii)* of Lemma 2, the ordering of profit levels according to unionization structures is reversed for both national and international firms. Obviously, this depends on the fact that for $t < 1/6$ the national market becomes the “large” market for the labor unions.

National firms paying discriminatory wage rates will earn the lowest profits in comparison to paying uniform wage rates, as they cannot benefit from the intense competitive

conditions in the international market. Instead, labor unions will find it optimal to set high wage rates in the national markets and extract high rents from these firms. If competition in the international market is intense, national firms should support the introduction of uniform wages.

Obviously, the two symmetric international unionization structures DD and UU will yield the same profit levels to the two international firms due to the specific functional forms, but profits will now be highest in a DU structure for the firm paying a discriminatory wage and earning $\Pi_{I_1}^{DU*}$ and consequently lowest for the firm paying the uniform wage rate and obtaining $\Pi_{I_2}^{DU*}$.

In this setting, the labor union opting for the uniform wage regime will set a wage \bar{w}^{DU*} which is higher than a discriminatory wage rate and thus reduces the competitive pressure in the international market. A uniform wage regime displays a commitment value: the labor union opting for the discriminatory wage regime will set a wage rate lower than \bar{w}^{DU*} which enables the firm to serve more than half of the international market. However, due to the uniform wage regime of the other union, it will not set an excessively low wage, so that $w_I^{DU*} > w_I^{DD*}$ prevails. Consequently, the profits obtained by the firm paying the discriminatory wage rate in structure DU , $\Pi_{I_1}^{DU*}$, are highest while those of the firm paying the uniform wage rate, $\Pi_{I_2}^{DU*}$, are lowest.

The comparison of profits and wage rates shows that either of the three international unionization structures can result in higher or lower wage rates and firm profits, depending on the intensity of competition in the international market. Foremost, we are interested in the opportunity for labor unions to refrain from setting discriminatory wage rates for heterogeneous firms and to opt for a uniform wage regime instead when there is international competition.

Taking wage bills, profits and consumer surplus into account, we can show that it is possible that firms, labor unions and consumers are better off (each in aggregate) under an international uniform structure than under a discriminatory unionization structure. As the following Proposition states, this can only occur when the international market is

the ‘small’ market from the unions’ perspective.

Proposition 1. *If the intensity of competition in the international market is relatively strong, so that $t < 1/6$ holds, then there exists a range of parameter values $t \in ((\sqrt{17} - 3)/24, (\sqrt{145} - 7)/96)$, such that labor unions, firms and consumers are each in aggregate better off under an international uniform than under an international discriminatory unionization structure.*

Proof. See Appendix.

If competition is sufficiently intense in the international market the averaging effect of a uniform wage will induce the wage rate paid by the firms in the international market to rise while that of the national firms will fall. Only if this is the case producer surplus will be higher under an international uniform structure (UU). National firms gain through lower wage rates caused by the intense competition in the international market.

Consumer surplus will only increase if the gain of consumers in the national market can offset the loss in consumer surplus in the international market due to a higher price. A prerequisite is that competition in the international market is sufficiently intense so that the increase in labor costs (and consequently consumer prices) is sufficiently moderate. The less market power the firms have, the more limited is the power of a labor union to increase the wage rate in the given market. The condition for consumers to be better off on aggregate is therefore given by $t < (\sqrt{145} - 7)/96$.

This is the upper threshold on parameter t derived in Proposition 1. For any $t > (\sqrt{145} - 7)/96$ consumers as a whole will not benefit through a joint uniform unionization structure. Wage (and price) increases in the international market would be too high.

Finally, labor unions gain if markets are not too heterogeneous, i.e., if the increase in the wage rate in the international market can compensate for the decrease in the wage rate paid by the national firms. Wages in the international market can only be increased sufficiently if firms have enough market power, i.e., if competition is not too intense which yields the lower bound on the transportation cost parameter t stated in Proposition 1; namely $(\sqrt{17} - 3)/24 < t$.

For any $t < (\sqrt{17} - 3)/24$, labor unions cannot raise the wages in the international market sufficiently to offset the loss in wage bill through lower national wage rates.

We are aware of the fact that this result hinges upon the functional forms used in our example. Nevertheless, we observe that there is scope for uniform wage regimes by unions to be beneficial not only for the labor unions themselves, but also for firms and consumers. Quite intuitively, this is likely to be the case when international competition puts downward pressure on collective wage agreements (i.e., $t < 1/6$ holds). Moreover, international competition must not be too strong as this would induce unions to revert to discriminatory wage regimes that aim at extracting rents from the remaining monopoly power in national markets.

4 Equilibrium Wage-Setting Regimes

Although wage-setting structures seem to be rather rigid institutions, recent changes suggest that in the long-run wage-setting regimes can be adapted by labor unions. When we endogenize the decision on wage-setting regimes, we are able to analyze the incentives for labor unions to opt for either a uniform or a discriminatory wage regime.

This decision is particularly interesting, when unions have the opportunity to observe and react to the wage regimes of labor unions in foreign countries, anticipating that the own wage regime choice will affect a firm's stand in international competition.

We analyze this choice sequentially to incorporate the option that labor unions react to the wage-setting regimes by foreign rivals. We have solved for the final wage bills obtained by labor unions in each unionization structure in the Appendix. Table 1 presents the choice of the labor unions in the first two stages 1a and 1b of the game between either uniform (U) or discriminatory (D) in a reduced form, indicating the associated wage bill levels, a union will obtain for either choice.

To find the equilibrium choice of wage regime, we need to consider two wage bill comparisons: namely union 2 choosing a discriminatory or a uniform wage-setting regime, given that union 1 has either adopted a discriminatory or a uniform regime. From Table 1

it is straightforward to determine the preferences of the two labor unions for either wage-setting regime and to calculate the subgame-perfect equilibrium wage regime choices.

Union 1 \ Union 2	D	U
D	U_1^{DD*}, U_2^{DD*}	U_1^{DU*}, U_2^{DU*}
U	U_1^{UD*}, U_2^{UD*}	U_1^{UU*}, U_2^{UU*}

Table 1. Normal Form Representation of the Wage Regime Choices

We find that the equilibrium wage regimes -and therefore the international unionization structures which will result in equilibrium- depend on the intensity of competition in the international market.

Proposition 2. *If labor unions choose their wage-setting regimes sequentially, then there exist critical values $0 < \underline{t} < t' < \bar{t} := 1/6$ such that the resulting international unionization structures (DD , UU , DU) can be sustained as equilibrium unionization structures:*

i) If $t \in (0, \underline{t}) \cup (\bar{t}, \infty)$, then the unique equilibrium unionization structure is international discriminatory (DD).

ii) If $t \in (\underline{t}, t')$, then the resulting unionization structure is international asymmetric (DU), where the first union adopts a discriminatory wage regime.

iii) If $t \in (t', \bar{t})$, then the unique equilibrium unionization structure is international uniform (UU).

Proof. See Appendix.

Any of the three international unionization structures analyzed in this paper can occur in equilibrium depending on the value of the transportation cost parameter t . For $t \in (0, \underline{t})$ and $t \in (\bar{t}, \infty)$ the equilibrium unionization structure is given by DD . When competition intensity is very high or very low between the international firms, both unions will find it beneficial to choose a discriminatory wage regime to extract as much rent as possible from the firms. In such a case, firms are so heterogenous that labor unions do not find it beneficial to forego a higher wage rate in one market in order to obtain a higher wage in

the other. If competition is too intense, a union could not profitably raise the international wage rate through uniformity to offset the loss due to a lower wage rate in the national market.

Note that the interests of firms and labor unions are only partially aligned here. If $t \in (\bar{t}, \infty)$, national firms prefer discriminatory wages just as unions do. As we showed in the previous section a uniform wage would cause a rise in wage for the firms (compared to the discriminatory level) and therefore lead to lower profits. If, however, $t \in (0, \underline{t})$, national firms would prefer uniform wages in order to benefit from the intense competition in the international market through a lower wage level. This preference is contrary to that of the labor unions.

For an intermediate degree of competition in the international market, both unions prefer uniform wage-setting regimes. If firms are not too heterogenous labor unions will benefit from a uniform wage. As $t < \bar{t} := 1/6$, the averaging effect of uniformity will work in the direction that the wage rate paid by international firms is higher, and that paid by national firms lower than if both unions had adopted discriminatory wage regimes. The gain for the union through setting a higher international wage rate here is large enough to compensate for the lowered wage rate in the national market.

From the viewpoint of a labor union, it can make sense not to exploit the differences in competitive conditions in the two product markets through discriminatory wages. The presence of international competition (and a rival union) in one of the markets adds a strategic motive to the choice of uniform wages. Obviously, a labor union will be willing to sacrifice its freedom to discriminate between markets if the losses in the wage bill due to a lower wage in one market will be offset by the higher income from the other market. As wages are strategic complements among unions, a choice of a uniform wage regime will have the effect of dampening competition in the international market for $t < \bar{t}$.

Finally, for $t \in (\underline{t}, t')$ we obtain an asymmetric equilibrium unionization structure where one union sets a discriminatory wage and the other sets a uniform wage. Note that a comparison of wage bills yields that in such a situation, the union setting the

discriminatory wage obtains a higher wage bill than the one setting the uniform wage. Consequently, in an asymmetric equilibrium resulting in unionization structure DU , it will be the union which has the first mover advantage (union 1) which will choose the discriminatory wage-setting regime. The rival union 2 will respond with its best reply in stage 1b: choosing a uniform wage regime.

Again, we can observe the commitment effect of uniformity: union 2 adopting a uniform wage-setting regime commits itself to set a relatively high wage rate, thereby providing a basis for the rival union to set a discriminatory, but higher wage rate than it would have been optimal if both unions had adopted discriminatory wage regimes. Both unions gain: the union which discriminates will set a wage rate such that the firm paying it will serve more than half of the international market. The labor union committed to uniformity will optimally set a higher uniform wage compared to unionization structure DD . Union 1 setting the discriminatory wages can free-ride on the dampening of competition in the international market union 2 provides.

We analyzed the effects on firms' profits in Section 3. A uniform wage regime by one union will suffice to reduce the competitive pressure in the international market. Since firms can perfectly observe the wages set by both unions, an international firm paying a discriminatory wage will respond to an increased labor cost of its rival by a higher price in the product market. Therefore, competitive pressure is reduced and the union setting uniform wages will gain from a uniform wage regime which dampens competition.

A comparison of the equilibrium unionization structures with the results of the previous section reveals that labor union preferences and consumer interests are not aligned. Although consumers and labor unions would be better off in structure UU for $t \in ((\sqrt{17} - 3)/24, (\sqrt{145} - 7)/96)$, unions will choose discriminatory wage regimes, if they determine them non-cooperatively, resulting in unionization structure DD . This problem could be resolved if unions were able to coordinate their wage-setting regimes internationally and form a joint international unionization structure. This result is in line with the observation that labor unions have increased their activities on the European level

(Schulten, 2002) to coordinate wage-setting regimes; an initiative which obviously mirrors increasing competitive pressure in international markets.

5 Conclusion

The model presented in this paper provides an analysis of labor union preferences for discriminatory or uniform wage regimes vis-à-vis heterogeneous firms when national labor market institutions are linked through international competition in product markets. Although the model is based on specific functional forms, its implications may contribute to a better understanding of the development of labor market institutions.

With heterogeneous firms, a comparison of discriminatory and uniform wage-setting regimes reveals the averaging effect of uniformity we have analyzed above. As presented in our model, labor unions have to compare the benefits through an increased wage rate for one type of firm to the loss through a reduced wage rate paid by the other.

In a more general model, we could therefore observe this trade-off for labor unions, though the scope for an international uniform unionization structure would be less obvious. Nevertheless, we have characterized a situation in which unions, firms and consumers as a whole gain through uniform wages in both countries. Interestingly, such a constellation is only likely if international competition puts downward pressure on collective wage agreements.

An important insight of our model refers to the profitability of a uniform wage-setting regime to unions even if a rival union has adopted a discriminatory wage regime. This commitment effect of uniformity is not new, but supports the observation that labor unions stick to centralized, uniform wage bargaining structures even when labor markets in foreign countries are more flexible and allow for undercutting regimes.

The commitment value of uniformity by one union provides a basis for the other union to set a discriminatory wage above the level of an international discriminatory unionization structure. In turn, the former will slightly benefit from this lessening in competition in terms of wage bill rents. In the sequential order of wage regime choices, the union which

moves first is clearly in the better position: it will optimally choose the discriminatory wage regime since it correctly anticipates that the other union will respond with a uniform wage regime.

A comparison with the results from Section 3 suggests that consumer and union preferences are not aligned. Although consumers and labor unions would be strictly better off in structure UU for $t \in ((\sqrt{17} - 3)/24, (\sqrt{145} - 7)/96)$, non-cooperative decisions of labor unions over wage-setting regimes will result in an international discriminatory unionization structure. An international coordination of labor unions over wage regimes as described by Schulten (2002) could resolve this problem.

Appendix

We solve our model for the three different unionization structures DD , UU , and DU . In the main part of this paper, we derived the wage levels. In this Appendix we present the solutions for profits, wage bills, and consumer surplus.

International Discriminatory (DD):

$$\Pi_N^{DD*} = \frac{1}{16}, \quad (3)$$

$$\Pi_I^{DD*} = \frac{t}{2}, \quad (4)$$

$$U^{DD*} = \frac{1}{8} + \frac{3t}{2}, \quad (5)$$

$$CS_N^{DD*} = \frac{1}{32}, \quad (6)$$

$$CS_I^{DD*} = \vartheta - 4t. \quad (7)$$

International Uniform (UU):

$$\Pi_N^{UU*} = \frac{1}{4(1+6t)^2} \quad (8)$$

$$\Pi_I^{UU*} = \frac{t}{2} \quad (9)$$

$$U^{UU*} = \frac{6t(1+3t)}{(1+6t)^2} \quad (10)$$

$$CS_N^{UU*} = \frac{1}{8(1+6t)^2} \quad (11)$$

$$CS_I^{UU*} = \vartheta + \frac{1}{1+6t} - 1 - t \quad (12)$$

International Asymmetric (DU):

In the labor union in country 1 adopts a discriminatory wage-setting regime:

$$\begin{aligned} \Pi_{N1}^{DU*} &= \frac{1}{16}, \\ \Pi_{I1}^{DU*} &= \frac{2t(2+3t)^2}{9(1+4t)^2}, \\ U_1^{DU*} &= \frac{3+8t[11+6t(5+3t)]}{24(1+4t)^2}. \end{aligned} \quad (13)$$

The labor union in country 2 adopts a uniform wage-setting regime:

$$\begin{aligned}
\Pi_{N2}^{DU*} &= \frac{(t-1)^2}{4(1+4t)^2}, \\
\Pi_{I2}^{DU*} &= \frac{2t(1+9t)^2}{9(1+4t)^2}, \\
U_2^{DU*} &= \frac{25t(1+3t)}{6(1+4t)^2}.
\end{aligned} \tag{14}$$

Proof of Proposition 1. The proof of Proposition 1 follows immediately from the comparison of wage bills, profits and consumer surplus under the international uniform and international discriminatory unionization structures. A labor union will only be better off under UU if it earns a higher wage bill than in a DD structure, i.e., $\Delta U = U^{UU*} - U^{DD*} > 0$. Using (5) and (10) we obtain $\frac{1}{8} \left[3 - 12t - \frac{4}{(1+6t)^2} \right] > 0$. Solving this expression for t we find that the inequality is fulfilled for $(\sqrt{17} - 3)/24 < t < 1/6$.

For firms to be better off under UU , we have to verify that producer surplus exceeds that under DD . Since $\Pi_I^{UU*} = \Pi_I^{DD*}$, it is sufficient to show that $\Delta \Pi = \Pi_N^{UU*} - \Pi_N^{DD*} > 0$. Using expressions (3) and (8) and solving for t , we find that firms are on aggregate better off under a uniform structure for $0 < t < 1/6$.

Finally, we analyze when overall consumer surplus increases, is that $\Delta CS = CS_I^{UU*} + 2CS_N^{UU*} - (CS_I^{DD*} + 2CS_N^{DD*}) > 0$ holds. Substituting (6), (7), (11) and (12), we obtain that consumers are better off if $0 < t < (\sqrt{145} - 7)/96$ or $t > 1/6$. Analyzing the above obtained results, it is easy to see that there exists a range of values of the transportation cost parameter where unions, firms, and consumers are better off under UU than under structure DD . This is the case, whenever $(\sqrt{17} - 3)/24 < t < (\sqrt{145} - 7)/96$ holds.

Proof of Proposition 2. Again, the proof of Proposition 2 involves a comparison of the wage bills the unions obtain under all three unionization structures. Using (5), (10), (13) and (14), the unions' decision problems in stages 1a and 1b can be displayed by the reduced form game presented in Table 1.

Comparing the resulting wage bills, we find that the equilibrium unionization structure depends on the intensity of competition in the international market.

Suppose union 1 chooses D in stage 1a, international discriminatory (DD) will be an

equilibrium structure only if $U^{DD*} - U_2^{DU*} > 0$; i.e., if $\frac{1}{8} + \frac{3t}{2} - \frac{25t(1+3t)}{6(1+4t)^2} > 0$. The difference $U^{DD*} - U_2^{DU*}$ has three roots of which only two are feasible; namely, $\underline{t} := (\sqrt{409} - 11)/96$ and $\bar{t} := 1/6$. These solutions give rise to the result stated in part *i*) of the Proposition; namely, that *DD* is the equilibrium union structure, if $t \in (0, \underline{t})$ or if $t \in (\bar{t}, \infty)$.

Similarly, we can determine when uniformity is a best response for union 2 given that the union 1 has chosen a uniform wage-setting regime. This is the case when $U^{UU*} - U_1^{DU*} > 0$. The sign of the difference $U^{UU*} - U_1^{DU*}$ is given by the sign of the expression

$$5184t^5 + 3456t^4 + 432t^3 - 180t^2 - 20t + 3.$$

That expression has only two feasible real roots; namely, $1/6$ and $t' := 0.10112$ (the latter solution is derived numerically). It is now easily checked that *UU* is the unique equilibrium union structure for $t \in (t', \bar{t})$.

We, finally, determine when unions prefer an asymmetric outcome. This is the case when both conditions $U_1^{DU*} - U^{UU*} > 0$ and $U_2^{DU*} - U^{DD*} > 0$ hold. It then follows from our previous results, that an asymmetric union structure emerges in equilibrium for $t \in (\underline{t}, t')$. Comparing the unions' wage bills (13) and (14) we obtain that the difference $U_1^{DU*} - U_2^{DU*}$ has two roots, $1/6$ and $1/2$, and obtains a global minimum at $t = 1/3$. As *DU* is only an equilibrium outcome for $t \in (\underline{t}, t')$, we can conclude that $U_1^{DU*} - U_2^{DU*} > 0$. Hence, the union which possesses the first mover advantage regarding the choice of wage-setting regime always selects a discriminatory regime. Finally, the ordering of the critical values fulfill $0 < \underline{t} < t' < \bar{t} := 1/6$.

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