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# Flexibility in Wage Setting Under the Threat of Relocation\*

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September 2017

## Abstract

Relocation of production to countries with low labour cost have induced increased labour market flexibility, which has been praised as a silver bullet for economic growth and low unemployment. Within a unionised oligopoly framework, in which a multi-national firm has the option to relocate its production to a foreign country, we analyse the welfare implications of both centralised and flexible wage setting regimes. For very low foreign wages, wage flexibility leads to higher welfare than a rigid centralised regime. In contrast, for “intermediate” wage levels in the foreign country, an industry-wide uniform wage leads to higher social welfare than flexible wages.

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*Keywords:* Union, Centralised Wage, Wage Flexibility, Relocation, Labour Market Flexibility.

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# 1 Introduction

The relocation of production has become a challenge for most developed countries in recent decades (Pedersini, 2006). While inbound foreign direct investments (FDIs) have rarely been opposed, outbound FDIs have been held responsible for the loss of employment and lower economic growth in the originating countries.<sup>1</sup> One of the main reasons for firms to move their production abroad lies in the lower labour cost in the destination countries. Using a representative survey of German firms, Kinkel and Maloca (2009) find that 96 percent of all firms agree that labour cost are an important driver of outward FDI.

Furthermore, rigid labour market institutions are seen as a cause for outbound FDI. In particular, when wage agreements cannot be adjusted to firm-specific conditions, the relocation of production to obtain more favourable agreements may become more attractive. Hence, the level of wage negotiations (centralised versus firm-specific) may be one factor preventing or promoting production abroad. Decentralising wage negotiations to firm-specific negotiations might prevent relocation. Once workers accept more flexibility, job losses can be limited by renegotiations of work agreements at the firm level. For Germany, Dustmann et al. (2014, p. 168) even claim that the “main reason” for Germany’s transition from the sick man of Europe to an economic superstar with a high growth rate and a low unemployment rate were “the gradual changes within the system [which] led to an unprecedented decentralisation of the wage setting process from the industry level to the firm level.” These changes towards a more decentralised wage setting system have been in stark contrast to the developments in other European countries. Keune (2010, p. 12) shows that Germany, and to a smaller extent Ireland, have been exceptions within Europe until recently, where in general “opening clauses have not had a major effect on the collective bargaining systems which have been remarkably stable.” However, in August 2017, president Macron has put forward a package of reform proposals to increase labour

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<sup>1</sup>Ahn (2014) has recently shown that efficiency gains due to FDI improve welfare of the source country while competition effects harm the host country. However, this analysis abstracts from any possible employment losses or wage effects.

market flexibility similar to measures implemented in Germany.

We want to shed light on the question which of two labour market organisations –a centralised system with a uniform industry-wide wage rate or a flexible regime where the union can set firm-specific (discriminatory) wages– is welfare maximising under the threat of relocating production. We assume an industry with two firms competing in the final goods market and a monopoly union setting either a uniform industry-wide wage (“centralised wage setting”) or discriminatory wages (“flexible wages”).<sup>2</sup> One of the firms has an outside option (the multi-national firm) in case it rejects the union’s wage offer, while the other firm (the domestic firm) is bound to produce domestically. The multi-national firm can produce abroad at a given foreign wage, which determines the profitability of the relocation option.<sup>3</sup>

We find that the flexible wage regime results in higher welfare than the more rigid industry-wide wage system if the wage in the foreign country is very low when compared to the wage level the union would choose in the closed economy case (i.e., when there is no relocation threat). The reason is that for a very low foreign wage, the union will let the multi-national firm relocate under the centralised wage system to maximise its wage bill with the domestic firm. Under discriminatory wages relocation never occurs. The union will always lower the multi-national firm’s wage to make it indifferent between staying in the home country and relocating while keeping the domestic firm’s wage at the closed economy level. Thus, for very low foreign wages, firm-specific wages would prevent relocation, resulting in higher welfare than under a centralised uniform wage.

However, a centralised uniform wage is welfare enhancing whenever the foreign wage is moderately lower than the closed economy wage. For these “intermediate” foreign wages, the union finds it optimal under centralised wage setting to lower the uniform

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<sup>2</sup>We suppose that wage flexibility does not affect the monopoly position of the union, so that firm-specific wages remain coordinated. In an extension we also examine the case where wage-setting becomes truly decentralised in which case firms’ workforces start to compete against each other. See also Haucap and Wey (2004) for a description of the possible unionisation structures in a unionised oligopoly.

<sup>3</sup>We assume in our model that shifting production abroad is possible without any additional cost.

wage below the closed economy wage level to induce the multi-national firm to stay in the home country. Accordingly, the relocation option of the multi-national firm creates “buyer power” which reduces the uniform wage level for all firms in the industry which leads to a higher level of social welfare than under discriminatory wages (this relation was first analysed by Katz 1987; see below).

The intuition for these results follows from the interaction between product market competition and the union’s optimal wage setting policy. The ability of a firm to credibly shift production abroad depends on the foreign wage level. The lower the foreign wage the more attractive is the relocation option because the relocating firm can then also gain a relatively large market share in the home country which implies a relatively high profit. The union takes the relocation threat into account when making the wage offer. If wage setting is flexible the union will adjust the wage downward for the firm with the outside option while keeping the wage at the other firm (which is bound to produce domestically) at the closed economy level. With this kind of price discrimination the union can realise a higher wage bill than under a centralised wage regime. In the centralised regime it can only induce the multi-national firm to stay in the home country by lowering the uniform wage for both firms which makes this regime less attractive for the union but more attractive from a social welfare point of view because of the relatively lower wage (in particular, the domestic firm’s profit and consumer surplus are higher than under a flexible wage regime). This logic, however, only remains true as long as the union induces the multi-national firm to stay in the home country. If the foreign wage becomes very low this is not optimal any more and the union is better off when the multi-national firm produces abroad while it maximises its wage bill in the remaining domestic firm. In those instances, it is better from a social point of view to allow for flexible firm-specific wages. The union will then find it optimal to set a pair of wages such that the multi-national firm stays in the home country.<sup>4</sup>

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<sup>4</sup>Our results are in line with recent empirical works. Bachmann, Baumgarten, and Stiebale (2014) find that outward FDI going to Central and Eastern Europe decreases job security using linked individual-firm data. Other case studies show that relocation threats indeed trigger lower wages: Raess and Burgoon

We examine the robustness of our results concerning wage setting institutions and union utility. Basically, our results remain valid with some qualifications. When wage setting becomes more competitive with independent firm-level unions, the balance tilts towards this flexible regime from a social welfare perspective. The reason is simply the resulting lower wages. With regard to union utility we show that our results are reinforced when the union is more employment oriented while the opposite holds when the union is more wage oriented. More precisely, the centralised wage solution becomes more attractive from a union perspective when compared with the case of relocation. This is mainly attributed to the fact that the relocating firm's profit is reduced when the union becomes more employment oriented which implies a weaker threat of relocation.

Our paper is related to the FDI literature which emphasises the interaction between product market competition and union power in labour markets. Zhao (1995) and Ishida and Matsushima (2005) derive ambiguous effects of FDIs on welfare. Cao and Mukherjee (2013) consider inward FDI and find that they decrease domestic welfare if the multinational firm is sufficiently technologically superior to the domestic firm (see also Leahy and Montagna, 2012). Other works deal with the effects of union power on inward FDI and how labour market institutions may change in response to FDI (see Naylor and Santoni, 2003, Vlassis, 2009, and Vlassis and Mamakis, 2014). One finding is that a centralised wage setting regime is more friendly to inward FDI, which complements our finding that outward FDI can be deterred under centralised wage setting to the overall benefit of the home country. Other theoretical studies have been conducted on the role of domestic market institutions as potential determinants of FDI flows (Mezzetti and Dinopoulos, 1991; Bughin and Vannini, 1995; Straume, 2002; Naylor and Santoni, 2003; Lommerud et al., 2003; Hur and Zhao, 2009) and competition amongst countries for FDI (e.g., Lommerud, Meland, and Sörgard, 2003; Fumagalli, 2003).

Closely related to our work is the literature which analyses the impact of wage cen-  

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(2006) conclude in their empirical study on eight German factories that greater foreign investments tend to trigger wage concessions. Furthermore, unions may react strongly to relocation threats as Meardi et al. (2009) show in their analysis of twelve European plants in the automotive components sector.

tralisation (i.e., uniform wage setting) on product and labour market outcomes. In this regard, Egger and Etzel (2014), using a general oligopolistic equilibrium model, find that a centralised wage setting regime puts a country at a competitive disadvantage because firms will inevitably relocate into a more attractive country with lower wages. This is different to our model because we allow for the possibility that the union can incentivise a multi-national firm to stay in the home country by reducing the centralised wage accordingly. Zhao (1998) compares the impact of FDI on industry-wide and firm-specific wage bargaining. He shows that the adverse effects of FDI from a union's perspective are much lower under firm-specific wages which is related to our finding that a union always prefers discriminatory wages. Mukherjee and Suetrong (2012) study the impact of different wage setting regimes on outward FDI. This work only considers product market competition in the foreign country while the domestic product market is unaffected by FDI. Santoni (2014) also focuses on wage bargaining institutions, but his model only analyses a reduction in trade barriers. Leahy and Montagna (2000) examine a situation with one multi-national enterprise which can invest in the home country where it faces several local competitors. They assume that the multi-national firm has efficiency advantages which leads to the result that the multi-national firm prefers uniform industry wages. However, welfare in the home country is lower under a centralised wage setting than under flexible wages.<sup>5</sup>

Overall, our work is in line with the general insights of this literature such that multi-national firms avoid high labour cost and unions try to implement high wages while preventing firms from shifting production abroad. However, unlike our paper, most of the literature assumes that firms first decide about FDI while wage setting (or bargaining) occurs thereafter.<sup>6</sup> In contrast, we take the FDI option as a threat and ask how a labour

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<sup>5</sup>For an extension to efficient bargaining see Bughin and Vannini (2003). If the union power is sufficiently low, FDIs can be welfare enhancing within a decentralised efficient wage bargaining regime compared to centralised bargaining.

<sup>6</sup>An exception is Skaksen (2004). He shows that the mere threat of international outsourcing reduces the wage rate and increases employment in the domestic country compared to FDI. He uses a



union reacts to this threat with its optimal wage policy. In addition, and again in contrast to much of the above cited literature, we analyse how different labour market institutions affect product and labour market outcomes.

Our paper is also related to the industrial organization literature on third-degree price discrimination in input markets (with linear input prices) which has examined conditions for a ban on discrimination to increase social welfare. Katz (1987), Yoshida (2000), and DeGraba (1990) have developed three important arguments in favour of discrimination banning rules based on allocative, productive, and dynamic efficiency considerations, respectively. To some extent, all these arguments build on the fact that a uniformity rule constrains an upstream monopolist's market power.<sup>7</sup>

We analyse the welfare implications of relocation threats in institutional settings that are different to those studied by Leahy and Montagna (2000). In contrast to previous works, we do not assume that the multi-national firm has an exogenously given efficiency advantage. Instead, we model an asymmetric threat to shift production abroad by one of the firms. Our approach builds on Katz (1987), who assumes that a downstream firm has buyer power vis à vis an upstream monopolist through its ability to vertically integrate backwards. He finds that a uniform input price (or wage) is welfare enhancing compared to discriminatory prices (see also Inderst and Valletti, 2009, for a generalization of Katz, 1987).<sup>8</sup> The reason is that all downstream firms benefit from the buyer power of a single firm under uniform input prices. In contrast to Leahy and Montagna (2000) we show that the outside option of shifting production abroad may improve social welfare with an 

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representative single firm and thus cannot compare the effects of different wage-setting regimes.

<sup>7</sup>See also Herweg and Müller (2012) and Dertwinkel-Kalt, Haucap, and Wey (2016) who obtain opposite results when downstream entry is possible.

<sup>8</sup>Related is also the industrial organization literature on vertical restraints when buyers can buy from different suppliers. For instance, Rasmusen, Ramseyer, and Wiley (1991) have shown that an incumbent monopoly supplier can foreclose an alternative supply source with discriminatory prices. This outcome is related to our result that a discriminatory union will be able to keep a firm in the home country for a larger range of parameter values of the foreign wage than under a centralised wage with no such discrimination.

industry-wide wage setting. If the foreign wage level is sufficiently low, it is profitable for the union to let the multi-national firm produce abroad. If the foreign wage level is at an “intermediate” level, then the industry union sets a relatively low wage to incentivise the multi-national firm to stay in the home country.

Section 2 describes the model while we compare the welfare effects of the two bargaining regimes in section 3. Section 4 concludes.

## 2 The Unionised Oligopoly Model

Assume that two firms  $i = 1, 2$  produce a homogeneous good and compete in Cournot fashion in the domestic market. The (inverse) demand is given by  $p = 1 - x_1 - x_2$  where  $p$  is the market price and  $x_i$  is firm  $i$ 's output. We abstract from all cost other than labour cost. Firms use the same constant returns to scale technology which transforms one unit of labour input into one unit of output. The total cost firm  $i$  faces when producing  $x_i$  units is given by  $C(x_i) = x_i w_i$ , where  $w_i$  stands for the wage firm  $i$  has to pay for one unit of labour input.

Both firms are symmetric when production takes place in the domestic country. However, firm 1, the “multi-national” firm, has the option to shift production to facilities outside the home country. We abstract from transportation cost and assume that the fixed cost of setting up production facilities abroad for the multi-national firm are sunk. We further assume that the firm 2, the “domestic” firm, is restricted to domestic production.

If firm 1 produces abroad, it faces the effective wage rate  $w_f$  in the foreign country, which is exogenous in our model. The effective wage in a foreign country is the product of the wage rate (which can be the workers' reservations wage) and the input-output ratio (which is the inverse of the labour productivity). We set the reservation wage in the home country to zero, so that the effective wage abroad must be higher than zero in order to avoid an outcome in which the multi-national firm 1 will always produce abroad. This is reasonable if the labour productivity is sufficiently lower abroad than in the home

country. Alternatively, if the productivity is more or less the same abroad union power in the foreign country or a high minimum wage may lead to an effective wage, which is higher than the reservation wage in the home country.<sup>9</sup> We assume that all output produced abroad is sold in the domestic market.

If the multi-national firm 1 decides to produce abroad paying the wage rate  $w_f$ , we refer to this as the relocation scenario  $R$ . If the multi-national firm decides to produce domestically (national scenario), wages for both firms are set by the monopoly union in the home country. Within this scenario we distinguish two sub-scenarios. A monopoly union can either set an industry-wide wage for all firms in the industry (centralised wage setting or scenario  $C$ ) or it can set firm-specific wages (discriminatory wage setting or scenario  $D$ ). In regime  $D$  the union can set firm-specific wages which may be different because of wage flexibility. When firms are asymmetric discriminatory wages may favour one group of workers although both groups are represented by a single union. Such discriminatory wage setting outcomes can be found in the real world to circumvent short-term demand or supply shocks or relocation threats of single firms.

In the discriminatory case ( $D$ ) the union's utility is given by

$$U^D = w_1^D x_1^D + w_2^D x_2^D,$$

which is the total wage bill in the domestic country. In the centralised case ( $C$ ) the monopoly union only sets one wage for both firms, i.e.,  $w_1 = w_2 = w^C$  and thus the union's utility function simplifies to

$$U^C = w^C (x_1^C + x_2^C).$$

However, if the firm decides to relocate, the domestic union is only left with the power to

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<sup>9</sup>If we allow for relocation cost which have to be incurred in case of relocating production abroad it would be possible to allow for a foreign wage which is lower than workers' reservation wage in the home country. Our results are robust in this regard if relocation cost are not too large and the foreign wage is not too low.

set the wage for the remaining firm 2.<sup>10</sup> In this case the union's utility becomes

$$U^R = w_2^R x_2^R.$$

The timing of the game follows Katz (1987) and is as follows: In the first stage, the labour union sets either a central wage (under regime *C*) or firm-specific wages (under regime *D*). In the second stage, both firms observe the wage offer of the union and firm 1 decides whether to accept or reject the offer. Firm 1 has an outside option because it can relocate production abroad, while firm 2 is bound to produce at home.<sup>11</sup> Depending on firm 1's decision two subgames follow: *i*) the acceptance subgame (national scenario) and *ii*) the rejection subgame (relocation scenario). The acceptance subgame is reached if firm 1 accepts the union's offer. In the following third stage both firms set their quantities simultaneously (Cournot competition) and the game ends. The rejection subgame is reached if firm 1 rejects the offer in the second stage, which implies that it relocates to produce abroad (then facing the foreign wage  $w_f$ ).<sup>12</sup> In the third stage, the union sets a new wage for firm 2 only. In the fourth stage, both firms set their quantities simultaneously and the game ends.

We solve the game by backward induction to calculate the subgame perfect Nash equilibrium for each of the scenarios. For that purpose we solve first for the equilibrium in the rejection subgame which gives the solution to the relocation scenario. This gives

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<sup>10</sup>Firm 1 will always produce either everything at home or abroad. In case of indifference, we suppose that firm 1 produces everything in the home country.

<sup>11</sup>Firm 2 can never do better than accepting the offer, because it has no outside option available.

<sup>12</sup>Another modelling option would be to suppose that firm 1 has two production plants (one in the home country and another one abroad) already active in the initial wage setting stage. In that case, firm 1 will always produce only in the factory which faces the lower wage. This sort of "inside option" was invoked for instance in Lommerud et al. (2006) or Baye et al. (2016) to show how wage competition between unions located in different countries is intensified by international mergers. In this paper we highlight the outside option nature of the relocation threat which, we think, is often a better real-world description. Only very few firms operate many facilities in different countries which produce the same products, so that production can be shifted very easily in response to changing wages.

us the equilibrium profit level of firm 1 in the rejection subgame which determines the credible outside option of firm 1 in the second stage of the game. We can then solve for the subgame equilibrium of the entire game under regimes  $D$  and  $C$ . For the remainder of the paper, we assume that firm 1's outside option is binding in stage two, so that the union cannot implement the unconstrained wage bill maximising solution under regimes  $D$  and  $C$ . The relocation threat is only credible if the exogenously given wage rate abroad  $w_f$  is sufficiently low such that a relocation of the production is profitable.

**Assumption 1.** *We assume that  $w_f < 3/7$  such that the threat of firm 1 to produce abroad is credible.*

The derivation of this threshold value can be found in Appendix A2 (Proof I).

## 2.1 Product Market Game

We solve by backward induction. Consider the acceptance subgame is reached. Given wages  $w_1$  and  $w_2$ , the two firms maximise their profits

$$\pi_i = (p - w_i) x_i = (1 - x_i - x_j - w_i) x_i \quad (1)$$

by choosing the quantity

$$x_i = \frac{1 - 2w_i + w_j}{3}, \quad (2)$$

for  $i, j = 1, 2, i \neq j$ . Equation (2) describes firm  $i$ 's labour demand for any admissible pair of wages  $(w_1, w_2)$  set in the first stage of the game.<sup>13</sup> If firm 1 rejects the union's initial wage offer the rejection subgame is reached. This is the relocation scenario  $R$ , in which firm 1 faces the wage rate  $w_1 = w_f$ , while firm 2 receives a new wage offer from the union  $w_2 = w_2^R$ .

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<sup>13</sup>In regime  $C$  the wages are the same  $w_1 = w_2 = w$ , in which case (2) reduces to  $x_i = (1 - w)/3$  for  $i = 1, 2$ .

## 2.2 Labour Market Game

The union sets a wage that maximises the domestic wage bill. However, the union has to take into account that the wage can induce the multi-national firm 1 to shift production abroad. Thus, the union considers the multi-national firm's profits in case of relocation. Only if firm 1's profit with domestic production is higher than the profit after relocation it will produce domestically. In the following, we calculate equilibrium wages, prices and quantities for the three scenarios to establish which of these scenarios results in the highest union utility and will, thus, be chosen in equilibrium.

Before we analyse the three scenarios  $R$ ,  $D$ , and  $C$ , we solve for the closed economy case, which allows us to better understand the interdependencies between labour and product markets when relocation of production to foreign countries is a credible threat. In a closed economy (or, when the relocation threat is not credible; i.e.,  $w_f > 3/7$ ) the union maximises its wage bill  $U = w_1x_1 + w_2x_2$  given the firms' demand as stated in (2). The optimal wage charged for one unit of labour is then given by  $w^* = 1/2$  (for firms 1 and 2) under both a centralised and a discriminatory wage setting regime.<sup>14</sup> Because of the assumed symmetry of the firms (in terms of their production technologies and their homogeneous products) both regimes lead to the same labour and product market outcomes. In particular, firms' profits and the union wage bill are the same under both wage setting regimes. Allowing now firm 1 to relocate production to a foreign country introduces an asymmetry into our model which leads to different labour and product market outcomes under the two wage setting regimes.

**Relocation scenario (Case  $R$ ).** In the foreign country, the multi-national firm produces at the exogenous effective wage  $w_f$  and therefore  $w_1 = w_f$ . Thus, the domestic union's utility function only depends on the employment of the second firm. The union maximises

$$\max_{w_2^R} U^R = w_2x_2$$

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<sup>14</sup>Note that the closed economy solution would also prevail if in the short term production capacities are expensive and cannot be build up quickly, for example, to weaken union power.

by choosing the optimal  $w_2^R$ , where  $x_2$  follows from substituting  $w_1 = w_f$  in (2). The results for wages, quantities and prices in this and the following scenarios are summarised in Table A1; those for profits, consumers surplus, union utility and welfare are presented in Table A2, both in the Appendix A2. Interestingly, the optimal wage for firm 2 is given by  $w_2^R = (1 + w_f)/4$ , so that the optimal wage for firm 2 decreases the lower the foreign wage. The same holds for the union wage bill, so that stronger product market competition (induced by lower wages abroad) affects the wage and the wage bill negatively in the home country in the relocation scenario.

**Firm-specific discriminatory wages (Case D).** With firm-specific wages, the union may be interested in keeping both firms in the home country to increase employment and thus the union's wage bill. The multi-national firm stays in the home country if it is at least indifferent between relocation and home production, that is, if  $\pi_1^D \geq \pi_1^R$  holds. This solution can be referred to as the incentive corner solution following Katz (1987). The union maximises its utility by choosing both wages under this constraint. We can write the maximisation problem as follows:

$$\max_{w_1^D, w_2^D} U^D \text{ subject to } \pi_1^D(w_1^D, w_2^D) \geq \pi_1^R(w_f, w_2^R).$$

The constraint is binding if and only if  $\pi_1^D = \pi_1^R$  resulting in a one-to-one relation between the wage for firm 1 on the one hand and the wage for firm 2 on the other hand; that is, the function  $w_1(w_2)$ . The multi-national firm's wage equating the two profits depends positively on the wage of the domestic firm.<sup>15</sup> We get  $w_1$  as a function of  $w_2$ ; namely,  $w_1(w_2) = (4w_2 + 7w_f - 1)/8$  (see Appendix A1). Substituting  $w_1(w_2)$  into the union's maximisation problem, we obtain the optimal wage for firm 2,  $w_2^D = 1/2$ . Thus, the optimal wage of firm 2 is not affected by firm 1's threat of relocation when compared to the closed economy solution.<sup>16</sup> Substituting this into  $w_1(w_2)$ , we obtain the optimal

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<sup>15</sup>Since the constraint is quadratic in the wage, two solutions exist. Only one solution is in the feasible set.

<sup>16</sup>This result is specific to the assumed linear demand which can be seen from solving the Lagrangian of the union's constrained wage bill maximisation problem for a general demand function  $p(x_1 + x_2)$ .

wage for firm 1, which is  $w_1^D = (1 + 7w_f)/8$ . Note that  $w_1^D(w_f = 3/7) = 1/2$ , which is the unconstrained solution which would be achieved in the closed economy scenario. The lower the wage the multi-national firm 1 has to pay, the more attractive it is to stay in the domestic country compared to the outside option. The higher the threat of relocation (i.e., the lower the level of the foreign wage  $w_f$ ) the union lowers the wage for firm 1 while keeping the wage for firm 2 fixed at the closed economy level. Thus, when  $w_f$  decreases, the ability to discriminate becomes more and more important as the union wants to widen the difference between both wages.

It is optimal for the union to make the multi-national firm stay if  $U^D \geq U^R$ . Then, the union has a higher utility if the multi-national firm does not relocate. It can be shown that this condition can be split into an employment effect and a wage effect. Employment in the domestic country is always higher in equilibrium when both firms produce domestically than when firm 1 leaves. The same is true for the wages. We show that the wage rates of both firms in equilibrium are higher compared to the relocation scenario  $R$ . Thus, we find that the union strictly prefers  $D$  over relocation  $R$ , that is, if it can wage discriminate (compare proof II in the Appendix A3).

Comparing the equilibrium outcome under  $D$  with the closed economy case reveals that the union's optimal wages  $w_1$  and  $w_2$  respond differently to the relocation threat of firm 1. Given the threat of relocation is credible, the union adjusts the wage charged to firm 1 downward to keep firm 1 indifferent between production at home and abroad. By that firm 1's employment level is also fixed at the level it would realise when producing abroad. Interestingly, with discrimination, the union actually sets a wage for firm 2 that is independent of the foreign wage, and, thus, of product market competition; i.e., the same wage as in the closed economy case  $w_2^D = w^* = 1/2$ .

**A central wage (Case C).** Under a central wage regime, the union sets the utility maximising uniform wage rate  $w^C$  at which the multi-national firm is indifferent between

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Starting from the closed economy solution with  $w_1 = w_2 = 1/2$  the union always wants to shift profits to firm 1 by directly lowering  $w_1$  while keeping  $w_2$  at  $1/2$ . Intuitively, lowering  $w_1$  is a "cheaper" way to increase the profit of firm 1 than increasing  $w_2$ .



relocating and staying, that is  $\max U^C$  such that  $\pi_1^C \geq \pi_1^R$ . The constraint is binding in this case such that it directly yields the incentive corner solution which establishes the wage rate for both firms

$$w^C = \frac{-1 + 7w_f}{4}, \text{ with } w^C > 0 \text{ if } w_f > \frac{1}{7}.$$

Note that for a very low foreign wage,  $w_f < 1/7$ , a non-negative solution does not exist, so that the union can never implement in those instances an interior solution under regime  $C$  with firm 1 accepting the central wage offer. By construction, the multi-national firm's profit is equal across all scenarios  $\pi_1^R = \pi_1^C = \pi_1^D$ . However, we can establish that the domestic firm 2 realises a higher profit if the multi-national firm 1 leaves the domestic market than if it stays only if  $w_f > 1/3$ . If the competitive advantage of the multi-national firm is sufficiently high, the domestic firm would prefer that the multi-national firm stays, which would reduce the central wage for both firms.

Again, we need to examine when the union has an incentive to let the multi-national firm relocate. If the union wants the multi-national firm to stay it has to lower the uniform wage rate for both firms in a centralised regime. This can be profitable due to higher employment. However, it may be utility enhancing for the union to charge a higher wage from the domestic firm and to let the multi-national firm produce in the foreign country if the foreign wage rate is very low. For this decision, the union has to take both the negative employment and the positive wage effect of relocation into account. We can show that overall employment in the domestic country is always higher when the multi-national firm is induced to stay in the home country compared to the relocation scenario  $R$ .

Inspecting the wage effect, we see that  $w^C > w_f$  if  $w_f > 1/3$ . For a low foreign wage  $w_f < 1/3$  it holds that  $w_f > w^C$ . Thus, the net effect on the union's utility is unclear for low foreign wages. The critical foreign wage  $\bar{w}_f$  that makes the union indifferent in incentivising the multi-national firm to stay ( $U^C = U^R$ ) is given by  $\bar{w}_f = 1/5$ . If the foreign wage exceeds this threshold, the union will make the multi-national firm stay. However, if product market competition is sufficiently fierce in the home country due to

relatively low foreign wages ( $w_f < \bar{w}_f = 1/5$ )  $U^C < U^R$ .

In summary, if the foreign wage level is very low the union would have to lower the uniform wage. Then, it would be better off if the multi-national firm relocates since then it could extract higher rents by setting a relatively high wage for the domestic firm. This is in contrast to discriminatory wages, where the relocation scenario was always dominated by the incentive corner solution. For the remainder of the paper we will distinguish these two cases. If  $w_f < 1/5$ , we refer to low foreign wages, and if  $3/7 > w_f > 1/5$  we refer to intermediate foreign wages (compare Proof III in the Appendix A3).<sup>17</sup>

Comparing the equilibrium outcome under  $C$  with the closed economy case, we observe that the relocation option of firm 1 puts downward pressure on the uniform wage both firms have to pay. In contrast to the  $D$  regime, the relocation now impacts the labour market such that the wages for firms 1 and 2 decrease when the relocation threat becomes stronger. While the wage charged from firm 2 was independent of the product market under  $D$ , this is no longer the case under  $C$ , simply because there is no way to differentiate wages between the two firms.

### 3 Welfare Analysis

Welfare is defined as the sum of the consumer surplus, the union's utility and the profits generated in the home country. To analyse which scenario,  $C$  or  $D$ , results in higher welfare values, for scenario  $C$ , we need to distinguish between the two cases discussed above.

i) For intermediate foreign wages ( $3/7 > w_f > 1/5$ ), the union will choose wages to make the multi-national firm stay. Thus, we need to compare the welfare levels when the two firms produce domestically in a centralised ( $W^C$ ) or in a discriminatory setting ( $W^D$ ). Simple calculations for intermediate foreign wages show that  $W^C > W^D$  holds

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<sup>17</sup>The case of a high foreign wage with  $w_f \geq 3/7$  is not of further interest because then the relocation threat would not be credible and the union could realise the unconstrained solution as in the closed economy case.

always. Thus, when the multi-national firm is induced to stay in the home country by the union, the resulting welfare level with a uniform wage (scenario  $C$ ) is higher than in the differentiated wage setting scenario  $D$  (the corresponding proof IV can be found in the Appendix A4). An explanation for this result comes from noticing that social welfare can only be higher in the centralised regime than in the discriminatory regime when the sum of firm 2's profit and consumer surplus is higher under  $C$ .<sup>18</sup> Under wage discrimination, the union sets a wage for firm 2 which is independent of the foreign wage, and, thus, of product market conditions. By internalising both the employment and the wage externality on firm 1, the union maximises its rent from firm 2 by setting the closed economy monopoly wage for firm 2 ( $w_1^D = w^* = 1/2$ ). At the same time, it also maximises its rents from firm 1 (the wage rate is lower and the employment level is fixed by firm 1's binding profit constraint). Thus, all the adjustment is on firm 2's employment and profits, which implies that firm 2 is always better off in the  $C$  regime than in the  $D$  regime. In addition, when the wage is at an intermediate level, firm 1's relocation threat is rather low, so that the union can extract the greatest product market rents under  $D$ , by pushing industry profits down and increasing the price level. The latter leads to lower consumer surplus, so that social welfare is higher under  $C$ , where the wage in both firms is constrained by firm 1's relocation threat.

ii) For low foreign wages ( $w_f < 1/5$ ), we need to compare the welfare levels if both firms produce domestically in the discriminatory case ( $W^D$ ), and if the multi-national firm relocates ( $W^R$ ) in the centralised case. We show that in this case  $W^D > W^R$ , which means that the flexibilisation of wage setting would increase equilibrium welfare. The corresponding proof V can be found in the Appendix A4. This result is related to Skaksen (2004) who shows for firm-specific wages that international outsourcing decreases overall welfare compared to prevented outsourcing where the latter leads to lower wages and lower union utility but to higher social welfare. Proposition 1 summarises the results

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<sup>18</sup>This follows from the fact that the union always prefers  $D$  over  $C$ , while firm 1's profit is the same under all regimes with  $\pi_1^R = \pi_1^C = \pi_1^D$  in the considered parameter range.

of the welfare analysis in the different settings.

**Proposition 1.** *The ordering of union utility (wage bill) and social welfare under centralised (C) and discriminatory (D) wage setting depends on the foreign wage,  $w_f$ , as follows:*

*i) If  $1/5 < w_f < 3/7$  (intermediate foreign wage), then firm 1 is always made to stay in the domestic country and social welfare is highest under centralised wage setting (i.e.,  $W^C > W^D$  holds). Moreover, union utility is highest under discriminatory wage setting, with  $U^D > U^C$ .*

*ii) If  $w_f < 1/5$  (“low foreign wage”), then firm 1 relocates (R) to the foreign country under regime C and social welfare is highest under discriminatory wage setting (i.e.,  $W^D > W^R$  holds). Again, union utility is highest under discriminatory wage setting, with  $U^D > U^R$  holding.*

*Furthermore, if  $w_f \geq 3/7$  (“high foreign wage”) the closed economy equilibrium is realised under D and C.*

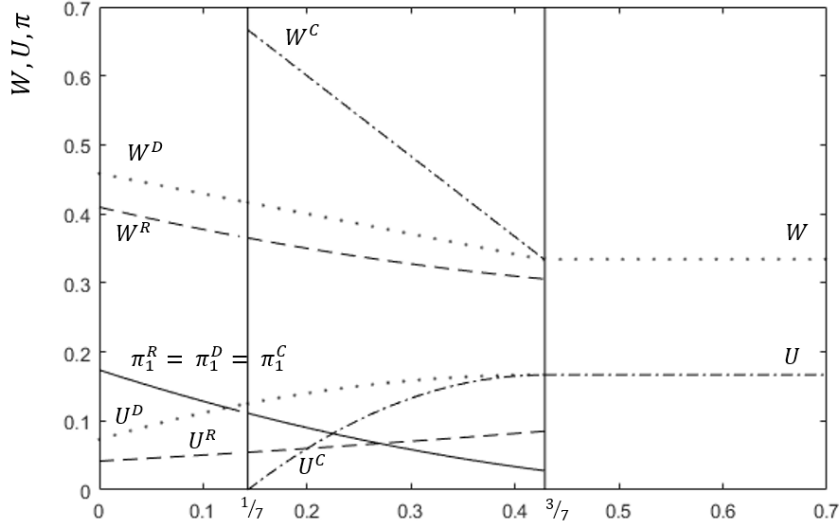
Figure 1 illustrates the ordering of the welfare functions, the union’s utility functions and the profits of the multi-national firm<sup>19</sup> in the three scenarios depending on the foreign wage level  $w_f$ . The central case C is only feasible if  $w_f > 1/7$  (positive utility), while the relocation threat is only binding if  $w_f \leq 3/7$ .

If the foreign wage level is higher than this upper bound, the closed economy equilibrium outcome is obtained both under the central and the firm-specific wage setting. The graph clearly shows that a decrease in the foreign wage level always increases overall welfare but decreases the union’s utility. A central wage leads to highest welfare but is not feasible for a low foreign wage. Only with a central wage and when the foreign wage is low ( $w_f < 1/5$ ), relocation will be preferred by the union. Then, the welfare level with relocation exceeds the welfare level with two domestic firms. However, for any  $w_f < 3/7$  the union always prefers firm-specific wages even if central wages would lead to a higher welfare level.

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<sup>19</sup>The profits of the domestic firm 2 always lie below the  $\pi_1$ .

Figure 1: Graphical comparison of the three scenarios



Union utility  $U$ , welfare  $W$ , and profit  $\pi_1$  depending on  $w_f$  (x-axis).

$\pi_2$  below  $\pi_1$  always (not presented). See Table A2 for details.

*D*: discriminatory wages (dotted line), *C*: central wage (dotted-dashed line), *R*: relocation (dashed line)

From this we can conclude that a welfare maximising government would implement a central wage if facing “intermediate” foreign wages. However, if the foreign wage falls below a certain threshold value, wage flexibility with discriminatory wages should be implemented to maximise welfare. Otherwise, the multi-national firm would relocate and the union would face a loss in employment in equilibrium. In terms of policy implications, this means that a government should only allow more flexible wage agreements if the wage in the foreign country is sufficiently low. If the foreign wage is at an intermediate level, a uniform wage leads to higher welfare due to a lower wage level for all domestic firms. This will lead to a redistribution from workers to firms, which may be preferred to a relocation of the whole production unit. Thus, for FDIs, we can only partly confirm the findings of Dustmann et al. (2014) from a theoretic point of view. Wage flexibility might only be appropriate for very low international wages.

## 4 Discussion and Extensions

In this section we discuss two extensions related to wage setting institutions under wage flexibility and to union utility.

**Wage setting institutions.** We have assumed that there is only one monopoly union also under wage flexibility. An implication is that wage flexibility actually increases monopoly power compared to a uniform wage. This view can be questioned in the sense that wage flexibility may lead to a more decentralised regime in which firms' employees start to compete against each other by setting firm-specific wages non-cooperatively. For instance, under a flexibility arrangement (as an opting out clause) work councils may gain more influence in firm-level wage setting and start to optimise the firm-specific wage given the wage prevailing in rival firms. This may be realistic if the work council's representative focuses more strongly on the wage bill of the employees it is representing than on the overall industry wage bill. In the extreme case, wage setting for firms proceeds fully independently and non-cooperatively. If we interpret wage flexibility this way, our results have to be qualified to some extent. In particular, wage setting by independent unions can be socially preferred when compared with centralised wage setting. Another difference is that the workers' total wage bill can be larger under the centralised solution so that workers would prefer a centralised wage setting regime over a decentralised one with independent firm-specific unions.

We first calculate the unconstrained solution (i.e., without considering the relocation threat) for the case of independent firm-specific unions. Let  $U_i$  be the wage bill at firm  $i = 1, 2$ . When the firms' work forces compete against each other, the wage bill at firm  $i$  is chosen to maximise  $U_i = w_i x_i$ , for  $i = 1, 2$ , where  $x_i$  is given by (2). We use the index  $I$  to denote the decentralised wage setting regime in this case.

Independent maximisation of the wage bills gives the subgame perfect wages  $w_1^I = w_2^I = 1/3$ . The associated equilibrium wage bill at firm  $i$  is then  $U_i^I = 2/27$ , for  $i = 1, 2$ , so that the industry wage bill is  $U^I = 4/27$ . Substituting the solution  $w_1^I = w_2^I = 1/3$  into the derived demands (2), it is straightforward to derive the firms' profits and the value of

social welfare which are given by  $\pi_i^I = 1/9$ , for  $i = 1, 2$ , and  $W^I = 38/81$ , respectively.

Comparing firm 1's profit level  $\pi_1^N = 1/9$  with the profit level it would realise in the relocation scenario  $\pi_1^R$  (see Table A2), we get that firm 1's profit is always larger under regime  $I$  than under  $R$  whenever  $w_f \geq 1/7$  holds. Thus, the unconstrained solution for regime  $I$  is not affected by firm 1's relocation threat for all  $w_f \geq 1/7$ . Note that this critical value corresponds to the threshold value which guarantees that the centralised wage solution is feasible.

In the following, we focus on the intermediate parameter values  $1/7 < w_f < 3/7$ , which is the range under which the centralised solution  $C$  is feasible and socially preferred to the discriminatory solution  $D$ .<sup>20</sup> The comparison of social welfare under regime  $I$  and regime  $C$  yields a unique threshold value  $\hat{w}_f = 59/189 \approx 0.31$  with  $\hat{w}_f \in [1/7, 3/7]$ , such that  $W^C > W^I$  for  $w_f < \hat{w}_f$  and  $W^C < W^I$  for  $w_f > \hat{w}_f$  (with equality holding at  $w_f = \hat{w}_f$ ). Thus, if the relocation threat is strong (i.e., relatively small effective wage abroad) the centralised regime leads to higher welfare than the independent unions case. If, to the contrary, the relocation threat is weak (i.e., relatively high foreign effective wage), then union competition under regime  $I$  leads to higher social welfare than under the centralised regime (with a monopoly union). Thus, if wage flexibility is associated with independent wage maximisation at the firm-level our result concerning the social superiority of centralised wage setting is overturned, whenever the relocation threat is rather weak (precisely, if  $w_f > \hat{w}_f$ ).

Another qualification emerges concerning the wage bill maximizing regime. While it was always optimal for the workers to opt for the differentiated wage setting regime  $D$  when compared to the centralised system  $C$ , it can now be optimal to choose the centralised regime  $C$  when regime  $I$  is the relevant alternative. Comparing the total wage bill under regime  $I$ ,  $U^I = 4/27$ , with the wage bill under regime  $C$  (see Table A2), we get that the former is larger for all  $w_f < 1/3$ , while the opposite holds for  $w_f > 1/3$  (equality

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<sup>20</sup>It is straightforward that for low values of  $w_f$ , with  $w_f < 1/7$ , decentralised wage-setting leads to lower union utility and higher social welfare under regime  $I$  (independent firm-specific unions) when compared with regime  $D$  (discriminating monopoly union).

holding at  $w_f = 1/3$ ). Interestingly, we find now that workers' wage bill can be larger under a centralised wage regime than under a decentralised one (but with independent unions, in contrast to regime  $D$ ). That means that workers as a whole would prefer strictly the centralised regime for all  $w_f > 1/3$  to avoid the negative wage competition effect under regime  $I$ . However, that choice would involve a lower social welfare level than under regime  $I$  because  $W^C < W^I$  for all  $w_f > \hat{w}_f \approx 0.31$ . If, however,  $w_f < 1/3$  holds, the workers' wage bill is maximal under  $C$  which would be the socially optimal choice as long as  $w_f > \hat{w}_f$ . If, finally,  $w_f < \hat{w}_f$  workers should again choose regime  $I$ , which is the socially inferior choice when compared to regime  $C$ . To sum up, when wage flexibility leads to wage setting by firm-specific independent unions, workers as a whole would prefer the centralised regime (for all  $w_f > 1/3$ ) which is then the socially inferior choice. Moreover, the centralised regime is not always the socially preferred whenever the foreign wage is at an intermediate level. This only remains true if the foreign wage is relatively low with  $w_f < \hat{w}_f$ .

**Union utility.** We have assumed that the union maximises workers' total wage bill. This specification makes sense when the union collects membership fees which are monotone in the wage bill, which is the case when workers pay a fixed share of their income as a membership fee.<sup>21</sup> A more general union utility function is the Stone-Geary functional form which allows for different degrees of wage/employment orientations and which nests the wage bill specification as a particular case (see Oswald, 1985). What changes when the union utility function allows for wage or employment orientation?

*First*, the union's preference for the discriminatory regime ( $D$ ) over the centralised one ( $C$ ) is not affected if we allow for wage or employment orientation (i.e., by using a

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<sup>21</sup>In Germany, the membership fee is typically 1 percent of the regular monthly gross income (see, for instance, Art. 14, Para. 1 of statute of the union *Verdi*). This rule is nicely reflected in the (to the Euro adopted) slogan "one cent of every euro makes us strong" ("*Ein Pfennig von jeder Mark macht uns stark*," which is a rhyme in German).



Stone-Geary functional form), as

$$U = w^{2a}x^{2(1-a)}, \quad (3)$$

where  $a \in (0, 1)$ .<sup>22</sup> The reason is here that the union can always implement the centralised solution under the discriminatory regime. In both regimes the maximisation problems stay the same with the only difference of an additional constraint under  $C$ , where  $w_1$  must be equal to  $w_2$ . Typically, the solution is different under both regimes, so that the utility level must be higher under  $D$  than under  $C$  (“revealed profitability”). We, therefore, conclude, that the union degree of wage/employment orientation does not matter for the choice of wage setting regime from the union’s viewpoint.

*Second*, the wage or employment orientation of the union does have an impact on the profit level of firm 1 in case of relocation (regime  $R$ ). This profit level depends on the union utility function. To see this, consider the union maximisation problem in case of relocation. It then maximises  $\tilde{U} = w_2^{2a}x_2^{2(1-a)}$  subject to firm 2’s labour demand (see (2)), which yields the solution  $\tilde{w}_2(a) = a(1 + w_f)/2$ . Note that  $\tilde{w}_2(a) = w_2^R$  for  $a = 1/2$  which corresponds to the solution under wage bill maximisation. However,  $\tilde{w}_2(a) > w_2^R$  for  $a > 1/2$  (i.e., wage orientation) and  $\tilde{w}_2(a) < w_2^R$  for  $a < 1/2$  (employment orientation). Substituting  $\tilde{w}_2(a)$  into firm 1’s relocation profit gives  $\tilde{\pi}_1(a) = (a - 4w_f + aw_f + 2)^2 / 36$  which is larger (smaller) than  $\pi_1^R$  (which is equal to  $\tilde{\pi}_1(a = 1/2)$ ) for  $a > 1/2$  ( $a < 1/2$ ). If the union becomes more employment oriented firm 1’s profit decreases relative to the case of wage bill maximisation. The intuition is that a stronger employment orientation leads to a lower wage  $w_2$  which reduces firm 1’s profit in case of relocation and vice versa. This affects whether the centralised wage setting regime  $C$  is optimal. The union’s uniform wage is determined by the indifference constraint of firm 1; i.e., the constraint which makes it indifferent between accepting the uniform wage offered by the union and relocation. The profit of firm 1 in case of accepting the centralised wage offer is  $\pi^C = (1 - w^C)^2 / 9$ . This

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<sup>22</sup>We multiply the weights by two in the union utility function to get wage bill maximization at equal weights  $a = 1 - a = 1/2$ .

profit level is equal to  $\tilde{\pi}_1 = (a - 4w_f + aw_f + 2)^2 / 36$  if the central wage is set to

$$w^C(a) = 2w_f - a(1 + w_f)/2. \quad (4)$$

As  $a$  increases (i.e., wage orientation increases) the relocation option becomes more attractive for firm 1. But this implies that the central wage (4) must be *reduced* to make the interior central solution possible. Thus, a centralised wage becomes less attractive for the union and therefore less likely as the wage orientation increases above the level of wage bill maximisation. Take the pair  $(w_f, a)$  at which firm 1 is indifferent between relocation and accepting the central wage offer under wage bill maximisation. As derived before, this pair is given by  $(1/5, 1/2)$ . If  $a$  increases (decreases) locally the critical value  $w_f$ , above which the union prefers the centralised outcome over the relocation scenario, is increased (reduced). This follows from taking the derivative of the union's utility under  $R$  and  $C$  with respect to  $a$  and then evaluating the derivative at the point  $(1/5, 1/2)$ .<sup>23</sup> We get that  $\partial \tilde{U}^R / \partial a \Big|_{a=1/2, w_f=1/5} > 0$ , while  $\partial U^C / \partial a \Big|_{a=1/2, w_f=1/5} < 0$ . For instance, if  $a = 0.55$  (i.e., wage orientation) the critical value for the foreign wage is  $w_f(0.55) \approx 0.237 > 1/5$  and if  $a = 0.45$  (i.e., employment orientation)  $w_f(0.55) \approx 0.167 < 1/5$ . We can thus conclude that the range of parameters  $w_f$ , under which the union prefers the central wage setting over relocation, must decrease when the union becomes more wage oriented. Conversely, if the union becomes more employment oriented firm 1's indifference constraint is easier fulfilled which makes the industry-wide wage setting solution more attractive. The range of  $w_f$  under which the centralised regimes is preferred to the relocation scenario then increases.

The fact that the centralised regime becomes more likely (i.e., the feasible region in terms of  $w_f$  is increased if the union becomes more employment oriented) is also mirrored in the threshold value  $w_f = 1/7$ , which guarantees a non-negative central wage. Setting the right-hand side of (4) to zero, we get the minimal critical value of the foreign

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<sup>23</sup>The union's utility in the relocation scenario with  $\tilde{w}_2(a)$  is  $\tilde{U}^R = (a(1 + w_f)/2)^{2a}((1 - 2(a(1 + w_f)/2) + w_f)/3)^{2(1-a)}$  while the union's utility in regime  $C$  with the optimal wage from equation (4) is  $U^C = (2w_f - a(1 + w_f)/2)^a (2(\frac{1 - (2w_f - a(1 + w_f)/2)}{3}))^{1-a}$ .

wage (denoted by  $\tilde{w}_f$ ) such that an interior solution under regime  $C$  exists—this value is  $\tilde{w}_f = a(4-a)$ . Note that  $\tilde{w}_f(a = 1/2) = 1/7$  which is the familiar critical value we derived under wage bill maximisation. Moreover,  $\partial\tilde{w}_f/\partial a > 0$ . Thus, this critical value is reduced whenever the employment orientation increases. Conversely, if the union becomes more wage oriented this critical value is increased, making an interior solution under regime  $C$  less likely. If a centralised regime has been chosen for some exogenous reasons, it will be more robust against relocation threats if the union is more employment oriented, while the opposite holds if the union is more wage oriented (with wage bill maximisation as the reference point).

*Third*, another issue of the union’s utility relates to the delegation problem between workers (the principals) and the union representative (the agent) whose objectives may differ. Suppose there is a constitutional stage “0” in which the union members decide about the wage setting regime. In this stage, aggregation of the members’ utility functions may give rise to a “union” utility function with either wage or employment orientation which can be different from wage bill maximisation. Members have to delegate wage setting to an agent (the union’s representative) who is known to maximise the wage bill. It may be infeasible for the members to implement a monitoring scheme different from wage bill maximisation. Under such a delegation problem the union members can only influence their agent’s wage choices by choosing a wage setting regime, which can be seen as a long run commitment device. If, for instance, the union members have a sufficiently strong employment orientation they will opt for the centralised regime. This would yield the highest employment level. Conversely, if the union members have strong wage orientation, they are more likely to opt for the discriminatory regime  $D$  because this implies relatively high wage levels at the cost of lower employment levels.

## 5 Conclusion

Relocation of production to non-unionised and/or low wage countries is a well-known phenomenon inherent to the globalisation and opening of markets. A standard policy

solution has been to flexibilise the labour market in response to relocation threats moving away from “equal-pay-for-equal-work” standards. As we show, however, a uniform industry-wide wage can lead to higher welfare than more flexible firm-specific wages. This is because the union has an incentive to lower the industry-wide wage to a level that keeps the multi-national firm from relocating if the foreign wage level lies in a certain range. While the workers receive lower wages, more union members are employed. In contrast, if the union sets firm-specific wages, the union will increase the wage for the domestic firm and decrease the wage for the multi-national firm, where the latter then has a competitive advantage in the product market. In this situation welfare is lower than with industry-wide wages for the simple reason that the domestic firm has to pay a higher wage and employment decreases. However, if the foreign wage level is very low, firm-specific wages are welfare-maximising. Thus, we show for a range of parameter values that Katz’s (1987) results with respect to vertical price discrimination and the option of vertical integration of the input supplier also holds for unions as upstream suppliers where one firm has the outside option of leaving the country.

For decision makers, this result is especially relevant in unionised industries in which the wage level in competing countries is lower but sufficiently similar to the wage in the home country. Future research will focus on the generalisation of the model. Furthermore, it would be interesting to estimate empirically the union’s bargaining power and the credibility of the outside option in specific industries to identify the empirical welfare effect of relocation threats.

## Appendix

We assume throughout the paper that  $w_f \geq 0$  (non-negative exogenous foreign wage) which exceeds the reservation  $w_0 = 0$ . Furthermore, let  $w_f < \frac{3}{7} = w_f^\#$  for an incentive corner solution with a credible relocation threat to become feasible. Stable equilibria are defined by unique inner solutions.

**A1. Algebraic solutions for the three cases.** We provide the derivation of the

equilibrium wages under the three case  $R$ ,  $D$ , and  $C$ . Solving for the solution in case of relocation  $R$  straightforwardly follows from substituting firm 2's derived demand from (2) into the union's utility which gives  $U = w_2x_2 = w_2(1 - 2w_2 + w_f)/3$ , where we set  $w_1 = w_f$ . Maximization gives the optimal wage for firm 2  $w_2^R = (1 + w_f)/4$ , which implies a profit for firm 1 of

$$\pi_1^R = (5 - 7w_f)^2 / 144. \quad (5)$$

In case of  $D$ , we get the optimal wages from maximising the union's utility and using the derived demands as stated in (2). This gives the maximization problem

$$\max_{w_1, w_2 \geq 0} U = w_1x_1 + w_2x_2 = w_1 \left( \frac{1 - 2w_1 + w_2}{3} \right) + w_2 \left( \frac{1 - 2w_2 + w_1}{3} \right), \quad (6)$$

which is maximised subject to firm 1's indifference constraint  $\pi_1^D \geq \pi_1^R$ . Using (5), this constraint becomes

$$\left( \frac{1 - 2w_1 + w_2}{3} \right)^2 \geq \frac{1}{144} (5 - 7w_f)^2. \quad (7)$$

Suppose that the unconstrained solution to (6) fails to meet the constraint (7), which is true for all  $w_f < 3/7$  (see next subsection of this Appendix). Then the constraint must be binding and holds with equality. Solving the constraint (7) we get  $w_1$  as function of  $w_2$ ; namely,  $w_1(w_2) = (4w_2 + 7w_f - 1)/8$ . Substituting  $w_2(w_1)$  into the union's maximization problem (6), we get the optimal wage for firm 2,  $w_2^D = 1/2$ . Substituting this into  $w_1(w_2)$ , we get the optimal wage for firm 1, which is  $w_1^D = (1 + 7w_f)/8$ . Note that  $w_1^D(w_f = 3/7) = 1/2$ , which is the unconstrained solution to (6).

Finally, in case of  $C$ , we get the optimal industry-wide wage directly from solving firm 1's indifference condition (7) at  $w_1 = w_2 = w^C$  for  $w^C$ . The profit of firm 1 when it accepts the wage offer  $w^C$  is  $\pi_1^C = (1 - w^C)/9$ , while its profit in case of relocation is given by (5). Equating both expressions and solving for the centralised wage, we get  $w^C = (7w_f - 1)/4$ . Note that this wage is equal to the unconstrained solution of the union's maximization problem at  $w_f = 3/7$  and that  $w^C = 0$  at  $w_f = 1/7$ . Thus  $w^C$  is the solution whenever  $1/7 \leq w_f \leq 3/7$  holds.

**A2. Proof I. Binding outside option.** The international firm 1 will only threaten to relocate if the profits gained after relocation are higher than when staying in the domestic

Table A1: Wages  $w_i$ , quantities  $x_i$  and price  $p$  comparisons by case

	$R$	$D$	$C$
$w_1$	$w_f$	$\frac{1}{8}(1 + 7w_f)$	$\frac{1}{4}(-1 + 7w_f)$
$w_2$	$\frac{1}{4}(1 + w_f)$	$\frac{1}{2}$	$\frac{1}{4}(-1 + 7w_f)$
$x_1$	$\frac{1}{12}(5 - 7w_f)$	$\frac{1}{12}(5 - 7w_f)$	$\frac{1}{12}(5 - 7w_f)$
$x_2$	$\frac{1}{6}(1 + w_f)$	$\frac{1}{24}(1 + 7w_f)$	$\frac{1}{12}(5 - 7w_f)$
$p$	$\frac{5}{12}(1 + w_f)$	$\frac{1}{24}(13 + 7w_f)$	$\frac{1}{6}(1 + 7w_f)$

Table A2: Union's utility  $U$ , profits  $\pi_i$ , consumer surplus  $CS$  and welfare  $W$  comparisons by case

	$R$	$D$	$C$
$U$	$\frac{1}{24}(1 + w_f)^2$	$\frac{7}{96}(1 - w_f)(1 + 7w_f)$	$-\frac{1}{24}(5 - 7w_f)(1 - 7w_f)$
$\pi_1$	$\frac{1}{144}(5 - 7w_f)^2$	$\frac{1}{144}(5 - 7w_f)^2$	$\frac{1}{144}(5 - 7w_f)^2$
$\pi_2$	$\frac{1}{36}(1 + w_f)^2$	$\frac{1}{576}(1 + 7w_f)^2$	$\frac{1}{144}(5 - 7w_f)^2$
$CS$	$\frac{1}{144}(7 - 5w_f)^2$	$\frac{1}{576}(11 - 7w_f)^2$	$\frac{1}{36}(5 - 7w_f)^2$
$W$	$\frac{1}{144}(59 - 50w_f + 35w_f^2)$	$\frac{1}{24}(11 - 7w_f)$	$\frac{1}{6}(5 - 7w_f)$

country (leading to equal profits for central and firm-specific wages since the firms are then symmetric). Neglecting the relocation threat of firm 1, we calculate the union's optimal wage, which follows from maximizing  $U = w_1x_1 + w_2x_2$  with respect to  $w_1$  and  $w_2$  (alternatively, the union could maximise over a uniform wage  $w = w_1 = w_2$ , which gives the same solution because of the monopoly position of the union and the symmetry of the firms). Substituting the derived demand (2) into the union utility function and maximizing over  $w_i$  we get the first-order conditions  $\partial U/\partial w_i = (2w_2 - 4w_1 + 1)/3 = 0$  for  $i = 1, 2$ . Solving for the wages gives the optimal solution  $w_1 = w_2 = 1/2$ . It then follows that the profit of firm 1 is given by  $\pi_1 = 1/36$ . Comparing the profit for firm 1 with the

optimal profit in case of relocation (5), we get that the relocation threat is binding if

$$\pi_1^{domestic} \leq \pi_1^R \text{ or } \left(\frac{1}{6}\right)^2 \leq \frac{1}{144} (5 - 7w_f)^2.$$

Solving for  $w_f$ , we get that the relocation threat is credible whenever  $w_f \leq 3/7 = w_f^\#$  holds. Otherwise, for  $w_f > 3/7$ , the monopoly union can implement the unconstrained solution  $w = 1/2$ .

### A3. Utility Comparisons.

#### Proof II: the union's utility in the discriminatory versus the relocation case.

Compared to the foreign scenario  $R$ , the union has a higher utility if the multi-national firm's production is made to stay in the domestic country if

$$\begin{aligned} U^D &> U^R \\ w_1^D x_1^D + w_2^D x_2^D &> w_2^R x_2^R. \end{aligned}$$

When the multi-national firm leaves, the employment in the domestic country is  $x_2^R$ . Subtraction yields

$$x_1^D + x_2^D - x_2^R = \frac{1}{24} (7 - 11w_f) > 0 \text{ if } w_f < w_f^{\#\#} = \frac{7}{11},$$

which always holds since here we assume that  $w_f < w_f^\# = 3/7$ . In this case overall employment is always higher when both firms produce in the home country than if the multi-national firm relocates. Since we also find that the wage rates of both firms are higher compared to the international scenario  $R$ , in the welfare comparisons, we do not consider case  $R$  as a relevant equilibrium if wages are differentiated. It is clearly dominated by the incentive corner solution  $D$  from the union's perspective.

**Proof III: the union's utility in central versus relocation case.** Overall employment is always higher when the international firm is made to stay in the home country compared to the international scenario  $R$  since  $2x^C > x_2^R$  if  $w_f < w_f^\#$ . Looking at the wage effect, we see that  $w^C > w_f$  if  $w_f^\# > w_f > w_f^{++} = 1/3$ , thus, the union clearly profits from keeping the firm in the country if the foreign wage level is sufficiently high. For a

low foreign wage ( $w_f < w_f^{++}$ ) it holds that  $w_f > w^C$ . Thus, the net effect on the union's utility is unclear in that case. We calculate the relevant threshold by

$$U^C - U^R = -\frac{1}{12}(1 - 5w_f)(3 - 5w_f) = 0 \text{ for } w_f = \frac{1}{5}.$$

If the foreign wage exceeds this threshold of  $\bar{w}_f = \frac{1}{5}$ , the union will make the multi-national firm stay. However, if competition is sufficiently fierce in the home country due to the binding outside option with  $\frac{1}{5} > w_f$ , then  $U^C < U^R$ . The reason is that, if the foreign wage level is very low, with one central wage the union would have to substantially lower the wage for both firms. Then, relocation would be utility improving since the union could then set a higher wage for the domestic firm.

#### A4. Welfare Comparisons.

**Proof IV: welfare comparison for an intermediate foreign wage**  $w_f^\# > w_f > 1/5$ . If  $w_f^\# > w_f > 1/5$  (i.e. a moderate foreign wage), the union sets wages such that the international firm stays in the domestic country in equilibrium. Comparing the equilibrium outcomes stated above we get

$$W^C - W^D = \frac{1}{8}(3 - 7w_f) > 0.$$

Thus, when the multi-national firm is induced to stay in the home country by the union, the resulting welfare level with a uniform wage (scenario  $C$ ) is higher than under discriminatory wage setting (scenario  $D$ ). Under the respective circumstances, the equilibrium will be stable and will maximise profits and welfare.

**Proof V: welfare comparison if the foreign wage is very low with**  $w_f < 1/5$ . If  $w_f < 1/5$ ,  $U^C < U^R$  and the union would let the firm relocate with a central wage but not with firm-specific wages. Comparing equilibrium welfare levels we get

$$W^D - W^R = \frac{1}{144}(8w_f - 35w_f^2 + 7) > 0,$$

since  $w_f < 3/7$ . Since  $U^R < U^D$  and  $CS^R < CS^D$  hold always, a central wage leading to relocation would mean lower welfare than in the firm-specific set-up since in the latter case, the union would make the multi-national firm stay. Thus, the bargaining partners



should opt for firm-specific wages to keep the multi-national firm in the domestic country if the foreign wage level is sufficiently low.

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