UNIVERSITY OF GOTHENBURG
SCHOOL OF BUSINESS, ECONOMICS AND LAW

WORKING PAPERS IN ECONOMICS

No 625

Why Unions Reduce Wage Inequality, II: The Relation between Solidarity and Unity

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September 2015

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Why Unions Reduce Wage Inequality, II:
The Relation between Solidarity and Unity[*]

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September 2, 2015

Abstract

This paper demonstrates that the decisions by workers of different skills to unite to form industry unions is closely linked to the egalitarian wage policies that such unions pursue. These results help interpret the stylized facts about unions: that they not only increase wages but also reduce wage inequality. I also demonstrate that political caps on collectively negotiated minimum wages may reduce the wages of all blue-collar workers (cf. "internal devaluation"), but that they may also cause unions to disintegrate in the long run.

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1 Introduction

The main result of this paper is that workers of different skills unite to form an industry union if, and only if, such a union would pursue an egalitarian wage policy. I derive this result in a model where the distinguishing feature of an industry union is its ability to reallocate bargaining power between its different skill groups. This ability may be a strength, by conferring a strategic advantage vis-à-vis the employers. But it may also be a weakness, by exposing minorities to majority opportunism.

Sufficiency Sometimes, industry unions can redirect the bargaining power of skilled workers to increase the lowest wages and rely on the employers to voluntarily increase higher wages by the same amounts. The condition is that the employers need to maintain wage differences to protect firm productivity. If these "domino effects" are strong enough, relative to union bargaining power, an egalitarian wage policy will result in a higher wage for the skilled workers, both compared to the wage negotiated by a separate crafts union, and compared to the wage negotiated by an industry union with a skill-biased wage policy.[1] The skilled workers would then prefer forming an industry union to a separate craft union. And, once the industry union has been formed, they would also vote in favor of an egalitarian wage policy. Unskilled workers clearly prefer an industry union, when they know that such a union will focus all its bargaining power on the lowest wages. Thus, whenever domino effects are sufficiently strong for an industry union to pursue an egalitarian wage policy, such a union will be formed.

Necessity Once a democratic organization has been formed, any minority is exposed to the opportunism by the majority. This is also true for the least productive minority in an industry union. When the more productive majority has a strategic (or ideological) interest in pursuing an egalitarian wage policy, opportunism is clearly not a problem. Opportunism is a problem, however, when the majority does not have such an interest. The majority can then use the combined bargaining power of all workers to mainly enrich itself. Even the slightest bias in the wage policy in favor of the median worker means that the lowest wages would be set below the level negotiated by a separate union representing only the least productive labor. The least productive members then prefer to form an independent skill-specific union. Thus, whenever domino effects are not sufficiently strong for an industry union to pursue an egalitarian wage policy, such a union will not be formed.

Application 1: Effects of unions on wage inequality A large empirical literature suggests that unions not only increase wages but that they also reduce wage inequality.

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[1]The details of the comparison of the different policies within an industry union are presented in a companion paper (Stennek, 2015). The present paper focuses on the coalition formation aspects.

They reduce wage differences associated with skills, education and tenure, both between and within firms and plants.[2] Since unions primarily raise the lower tail of the wage distribution,[3] the unions' equity concerns appear to reach far beyond the median member's immediate self interest. However, also pure inequity aversion is an unlikely explanation since skilled workers are less supportive of union representation.[4]

The present paper argues that industry unions, when they are formed, will pursue egalitarian wage policies and, thus, reduce wage inequality. The reason is that the median worker may have a strategic interest in increasing the lowest wages. In contrast, I show that crafts unions, which divide labor according to skills, may increase or decrease wage inequality, depending on the circumstances.

This predicted difference between the two organizational forms suggests that also empirical studies of unions should make the same distinction. Actually, Ozanne's (1962) study of skill differentials in a single firm over a period of 100 years did so. During this time, the pattern of unionization varied. During periods when workers belonged to the same industry union wage differences became smaller but during periods when workers were divided into crafts unions wage differences increased. This pattern is clearly consistent with the predictions of the present paper.

Application 2: Caps on minimum wages in Europe Is a lower minimum wage part of the cure for the current economic problems in Europe? The International Monetary Fund, the European Central Bank and the European Commission believe so. The so-called troika demanded that Greece – the country worst off – cut its minimum wage by 20 percent as part of the conditions for a new financing package (Bloomberg, 2012). In Greece minimum wages are negotiated by the social partners before being turned into law and a Greek minister resigned arguing that the lenders "in a blackmailing way are crushing the edifice of labor relations" (The Guardian, 2012).

To understand what role minimum wages play in Europe, it is vital to understand how they are determined through collective negotiations. Such procedures is the norm in large parts of Europe, including Greece and Sweden but also e.g. Germany and Italy (Skedinger, 2012). Unfortunately, however, almost all research on minimum wages concern countries such as the United States and Canada where minimum wage levels are determined by lawmakers (Neumark and Wascher, 2007). This paper starts filling this gap.

My results indicate that a politically imposed cap on collectively negotiated minimum

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[2]The exact numbers depend on the country, the time period and the methodology used. See reviews by Freeman and Medoff (1984), Kaufaman (2002), Blanchflower and Bryson (2003) and Card, Lemieux and Ridell (2004). Recent studies, emphasizing causality, use a regression discontinuity design based on union certification elections and compare the outcomes in establishments where unions barely won with those where unions barely lost. See DiNardo and Lee (2004), Lee and Mas (2009) and Frandsen (2011).

[3]This feature was first noted by Freeman (1980). For a recent study based on a regression discontinuity design, see Frandsen (2011).

[4]See Farber and Saks (1980) and Parsons (1982).

wages may be a tool for reducing blue-collar wages in general. When the lowest wages are reduced, the employers can also reduce the wages further up in the distribution without compromising efficiency. Such a partial "internal devaluation" may well be a consequence intended by the troika. But my results nevertheless call for caution. First, if a reduction of blue-collar wages creates an opportunity for white-collar workers to increase their rents, the firms' wage costs may remain high. Second, if the unions pursue egalitarian wage policies for strategic reasons, a cap on the collectively negotiated minimum wage may threaten the unity among blue-collar workers in the long run.

2   Relation to previous literature

Previous theoretical research on union formation is focused on the effect of union structure on the wage level.[5] A main result is that different groups of workers can sometimes increase the wage share by forming a common industry union rather than separate crafts unions. In particular, an industry union increases worker bargaining strength if the workers are substitutes in production, but not if they are complements (Horn and Wolinsky, 1988).

But since the empirical literature suggests that unions reduce wage inequality among their members, in addition to increasing the wage level, it is important to understand why industry unions pursue egalitarian wage policies and how this choice interacts with union formation. The present paper shows that an industry union's ability to pursue an egalitarian wage policy may constitute another gain from unity, i.e. an egalitarian wage policy may actually increase the wage share. (In the present model, the workers are neither substitutes nor complements in order to eliminate the Horn-Wolinsky effect.)

Moreover, previous research on union formation has not dealt with the issue of opportunism and minority protection, presumably as a result of its focus on the wage level. Horn and Wolinsky assume that different worker groups will always find a way to share any surplus created by forming an industry union. Jun (1989) models this process in detail.[6] He assumes that an industry union can commit to a wage policy already when it is formed and that this policy is determined through bargaining between the worker groups. Jun does also not discuss the strategic role of the union wage policy, i.e. how different relative wage policies affect the wage level. The relative wage is simply seen as a tool for splitting the surplus between the worker groups. In addition, Jun assumes that the union itself can decide on the wage differences in the economy and that it only has to bargain with the employers over the wage level.

But even if an industry union has the potential to increase the overall wage share,

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[5]See Booth (1984), Horn and Wollinsky (1988) and Jun (1989). Also research where the union structure (and the locus of bargaining, i.e. centralization vs. decentralization) is exogenous has been exclusively concerned with effects on the wage level (Dowrick, 1990).
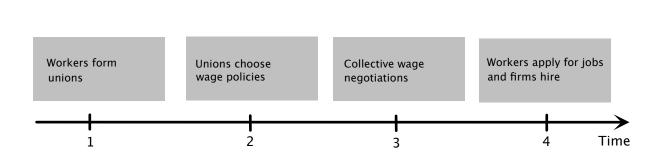
[6]Booth assume that all workers have the same productivity and must receive the same wage. (Workers only differ in their views on unemployment.)

for one reason or the other, it is not clear that heterogenous workers can unite, when they have diverging interests over the division of the wage share. Any minority may fear that, once an industry union has been formed, the majority would use the additional bargaining strength to not only bash the employers but also to exploit the minority. While the pattern of unionization evolves slowly, union wage policies can be changed more easily between the years. The adequate modeling strategy is therefore to require an industry union's wage policy to be decided after it has been formed. And since unions are democratic organizations, the ex post right to decide resides with the median member who is assumed to be skilled. The present paper demonstrates that, in the presence of domino effects, an egalitarian wage policy not only increases the wage share but also protects minorities from exploitation by the majority.

3   Model

The paper uses the same model as in Stennek (2015) extended with a coalition formation stage. The timing of events is described in figure 1. First, the workers decide whether to

Figure 1: Time Line

form a common industry union or skill-specific crafts unions (section 5). For simplicity there are only two types of (blue-collar) workers called unskilled ("the least productive") and skilled ("everybody else"). To abstract from any collective action problems within the groups it may be assumed that the workers are already organized in two crafts unions and that the issue is whether to merge these unions into a single industry union. Alternatively, it may be assumed that there is an industry union and that the issue is whether this union should be braked up. In any case, it is assumed that there will be an industry union if, and only if, both groups of workers prefer an industry union to two separate unions. Second, if an industry union is formed, the workers vote for a wage policy. The wage policy describes the union's preferences over wages in different jobs. This choice may also be thought of as electing the union leadership, which is responsible for the wage negotiations with the employers (section 4.3). To study why industry unions favor their least productive

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minorities, it is assumed that there are more skilled than unskilled workers. Crafts unions simply maximize the utility of their representative member. Third, the union(s) and the single firm bargain over the wages (section 4.3). Statutory minimum wages, if any, are not binding. Fourth, the workers decide which type of job they wish to apply for and the firms hire all applicants for which the expected profit is positive. The model is analyzed backwards, to establish a sub-game perfect equilibrium.

The model abstracts from important arguments against increased wage costs. Individual firms are not put at a competitive disadvantage by increased wages. There is also no unemployment in equilibrium, nor any possibility for inflation.

3.1 Job applications and hiring

The present section analyzes the fourth stage, job applications and hiring. The key property of this part of the model is that wage differences increase the firms' productivity. To make it simple, there are only two levels of productivity: productivity is high if the difference between the wages earned by skilled and unskilled workers exceeds a threshold; otherwise it is low. To be concrete, I use an adverse selection model. But the same formal model may be interpreted many different ways, as discussed in Stennek (2015).

Production   There are two types of jobs or techniques. Every worker who takes a "basic" job adds the value v^L to the firm and every worker who takes an "advanced" job adds the value $v^H > v^L$. The total value of production is simply the sum of values produced by the workers. For example, if all workers, skilled and unskilled, carry out basic jobs, the total value is v^L. But, if all the skilled workers carry out advanced jobs and all the unskilled workers carry out basic jobs, the total value is higher and given by $\lambda \cdot v^L + (1 - \lambda) \cdot v^H$, where $\lambda < \frac{1}{2}$ is the share of unskilled workers.[7]

Utility   A worker's disutility of effort is an increasing and convex function of the value produced. In particular, $d_i^j = d_i \cdot (v^j)^2$ for both skilled ($i = S$) and unskilled ($i = U$) workers. (Note that sub-indexes are used to differentiate worker types and super-indexes are used to differentiate jobs.) The disutility of effort is higher for the unskilled workers' than for the skilled workers, i.e. $d_U > d_S$. These assumptions entail that the usual "single crossing" conditions for screening in adverse selection models are satisfied.[8] The utility of a worker of type i who takes a job of type j is given by $u = w^j - d_i^j$, where w^j is the wage in job j. The utility outside employment is normalized to zero. Thus, the disutility of work must be interpreted broadly to include e.g. the lost value of leisure and unemployment benefits.

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[7]Notice that the two groups of workers are neither substitutes nor complements since the value produced by the different skill groups is independent of the presence of the other group.

[8]In particular, $d_U^L > d_S^L$ and $d_U^H - d_U^L > d_S^H - d_S^L$, are satisfied.

Efficiency The number of basic and advanced jobs are endogenous; they are determined by job applications and hiring decisions. Efficiency requires that the firms hire the unskilled workers to carry out basic jobs if

$$v^L - d_U^L > v^H - d_U^H, \tag{1}$$

and that the firms hire the skilled workers to carry out advanced jobs if

$$v^H - d_S^H > v^L - d_S^L. \tag{2}$$

These conditions are satisfied if $d_U > \left[v^H + v^L\right]^{-1} > d_S$, which is assumed.

The maximum total surplus is denoted by $S = (1 - \lambda) \cdot \left(v^H - d_S^H\right) + \lambda \cdot \left(v^L - d_U^L\right)$. The increase of the total surplus if skilled workers are employed in advanced jobs rather than in basic jobs is denoted by $\triangle S = (1 - \lambda) \cdot \left[\left(v^H - d_S^H\right) - \left(v^L - d_S^L\right)\right]$.

Information The firm and the union(s) bargain over the wages, w^L and w^H, but cannot decide on employment directly. Individual workers have private information about their skills and select which jobs they wish to apply for. The firm decides unilaterally what applicants it wishes to hire, but without observing their skills. The outcome is efficient if the combination of wages induce all workers to apply for the jobs they are suited for, while granting the firm a positive profit when hiring all applicants. In particular, the wage schedule has to satisfy both rationality and incentive compatibility constraints for both the workers and the firms.

Worker incentives The wages must compensate the workers for their disutility of work. The wage paid for basic jobs has to compensate the unskilled workers for their disutility of low effort and the wage paid for difficult jobs has to compensate the skilled workers for their disutility of high effort, i.e.

$$w^L - d_U^L \geq 0, \tag{3}$$

$$w^H - d_S^H \geq 0. \tag{4}$$

Unless these *individual rationality* constraints are fulfilled, the workers would prefer to remain unemployed. Expressed differently, the wage schedule must lie above the IR_S-line and to the right of the IR_U-line in figure 2, on page 9.

The wage structure must also induce the unskilled workers to voluntarily choose the basic jobs over the advanced jobs and the skilled workers to prefer advanced jobs to basic jobs, i.e.

$$w^L - d_U^L \geq w^H - d_U^H, \tag{5}$$

$$w^H - d_S^H \geq w^L - d_S^L. \tag{6}$$

These *incentive-compatibility* constraints place restrictions on wage differences. The skilled workers' incentive-compatibility constraint ("IC_S") requires the wage for advanced jobs to be sufficiently high compared to the wage for basic jobs. Whatever the wage for basic jobs is, the wage for advanced jobs must be larger and compensate the skilled workers for the extra effort required, i.e. $w^H - w^L \geq d_S^H - d_S^L > 0$. Expressed differently, the wage schedule must lie above the IC_S-line in figure 2. The incentive-compatibility constraint for the unskilled workers will be excluded from now on, since it will not play any role in the analysis to follow (think of d_U^H as extremely high).

Firm incentives The wage structure must grant the firm a non-negative profit. When the efficient outcome is implemented, the requirement is that $\pi = \lambda \cdot \left(v^L - w^L\right) + (1 - \lambda) \cdot \left(v^H - w^H\right)$ is positive. The wage structure must also ensure that the firms wish to hire both types of workers, i.e.

$$w^H \leq v^H \tag{7}$$

$$w^L \leq v^L. \tag{8}$$

These two *right-to-manage* constraints are described by the two dotted lines in figure 2.

Efficiency and division of surplus The gray area in figure 2, defined by inequalities (3) - (8), represents all wage schedules inducing maximization of the total surplus. While every such *efficient wage schedule* maximizes the total surplus, they entail different divisions of this surplus between the firm and the different types of workers.
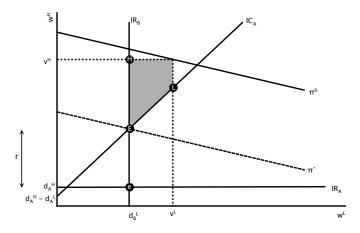
4 Wage setting

4.1 Unilateral wage setting

First consider the case when no unions have been formed and the employer has the power to set wages unilaterally. If the firm wishes to induce an an efficient outcome, it will choose the wage schedule described by the E-dot in figure 2 (which is the intersection of the IR_U and IC_S lines) to minimize wage costs. Thus, the unskilled workers are simply offered a compensation for their disutility of work, i.e. $w_E^L = d_U^L$. The skilled workers are offered $w_E^H = d_U^L + \left(d_S^H - d_S^L\right)$, where the second term is a compensating wage differential, to compensate the skilled workers for taking on more responsibility or acquiring a higher education. Notice that the skilled workers receive a wage in excess of the level sufficient to compensate them for their disutility of working:

$$u_H = w_E^H - d_S^H = \left[d_U^L + \left(d_S^H - d_S^L\right)\right] - d_S^H = d_U^L - d_S^L \equiv r > 0.$$

Figure 2: The firm sets both wages unilaterally

This *efficiency wage premium* is paid by the firm to prevent the skilled workers from accepting a low-paid low-effort job. Therefore, the efficiency wage premium has to be at least as high as the utility the skilled workers would derive from choosing a basic job $(w_E^L - d_S^H = d_U^L - d_S^L)$. In figure 2 the efficiency wage premium is described by the distance between the E-dot located on the incentive-compatibility constraint and the e-dot located on the individual rationality constraint.

Stennek (2015) shows that the firm indeed has an incentive to implement the efficient outcome (rather than e.g. not offering any low-effort jobs) if

$$\lambda \cdot \left(v^L - d_U^L\right) \geq (1 - \lambda) \cdot \left(d_U^L - d_S^L\right). \tag{9}$$

This condition requires that the unskilled workers' contribution to total production (which is equal to the left hand side of the inequality) is larger than the total efficiency wage premium paid by the firm (which is equal to the right hand side of the inequality).

4.2 Collective negotiations with two crafts unions

When the workers in basic and advanced jobs are organized in two different unions, the two wages are determined in two separate collective negotiations. The natural modeling strategy is to represent the two negotiations by two Nash bargaining problems. But even if the two negotiations are separate, they are interdependent. The reason is that the relative wage matters: the skilled workers may choose to apply for basic jobs in case the wage in basic jobs is relatively high compared to the wage in advanced jobs. Thus, the wage that the parties wish to agree upon in one negotiation may depend on the wage agreed in the other negotiation. A natural extension of the Nash bargaining model to handle such interdependence between the bilateral negotiations is to assume that the firm and each job-specific union will choose the wage maximizing their Nash product, *taking the wage agreed in the other negotiation as given*. One may call this a Nash equilibrium

in Nash bargaining solutions.[9]

I will focus on *efficient equilibria*. To do so, I first assume that skilled workers are organized in the advanced-jobs union and that unskilled workers are organized in the basic-jobs union. Then, I show that any equilibrium wage schedule indeed induces an efficient outcome, meaning that the skilled workers are hired in advanced jobs and unskilled workers are hired in basic jobs.[10]

Negotiation with the advanced-jobs union   Assume that, for some reason, the wage for basic jobs is given by $w^L \in \left[d_U^L, v^L \right]$. Such a wage would compensate the unskilled workers for the disutility of effort in basic jobs and provide a surplus to the firm. Consider now the firm's negotiation with the advanced-jobs union. I represent this negotiation by the asymmetric Nash bargaining solution. The union's objective is to maximize the wage premium, which is given by $w^H - d_S^H$, given that all workers in advanced jobs are skilled. The union's disagreement payoff is zero. The firm's objective is to maximize profit, which is given by $\pi = \lambda \cdot \left(v^L - w^L \right) + (1 - \lambda) \cdot \left(v^H - w^H \right)$ given that skilled workers are hired in advanced jobs and unskilled workers are hired in basic jobs. The firm's payoff in case of disagreement with the advanced-jobs union is $\lambda \cdot \left(v^L - w^L \right)$. The Nash product is then given by

$$N\left(w^H \right) = \left[(1 - \lambda) \cdot \left(v^H - w^H \right) \right]^{1 - \beta} \cdot \left(w^H - d_S^H \right)^{\beta}$$

where $\beta \in [0, 1]$ is the union's bargaining power.

The task is to find the wage w^H that will be agreed by the firm and the advanced-jobs union, for any possible $w^L \in \left[d_U^L, v^L \right]$. This *best-reply function* is easy to describe. Given that the advanced jobs workers are skilled, the firm and the union will agree on the wage splitting the skilled surplus $S_H = v^H - d_S^H$ in accordance with the parties bargaining power. That is, they will agree on

$$w_{NIC}^H = \beta \cdot v^H + (1 - \beta) \cdot d_S^H, \tag{10}$$

as long as this wage renders the wage schedule $\left(w_{NIC}^H, w^L \right)$ efficient. The notation "NIC" refers to the fact that this wage is the same as the wage that would be agreed with no incentive-compatibility constraint. But if w^L is so high that w_{NIC}^H would induce the skilled workers to apply for basic jobs, the firm would agree to increase the wage for advanced jobs above w_{NIC}^H. Then the agreement would stipulate the lowest level inducing the skilled

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[9]The use of a Nash equilibrium in Nash bargaining solutions to describe the outcome of interdependent bilateral negotiations was first suggested by Davidson (1988) and Horn and Wolinsky (1988b).

[10]The main benefit of focusing on efficient equilibria is that then both unions have homogenous members. Thus, their objective functions can simply be assumed to coincide with the members' utility function.

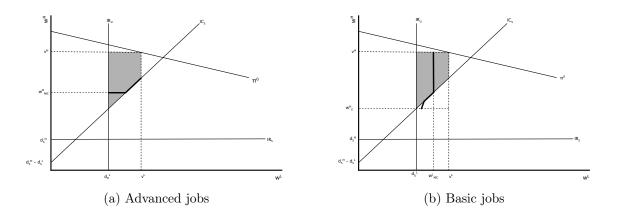workers to apply for difficult jobs, as defined by the IC-constraint, i.e.

$$w_{IC}^H \left(w^L \right) = d_S^H - d_S^L + w^L. \tag{11}$$

To see that the firm's profit is actually increased by increasing the wage, note that $v^H - w_{IC}^H \left(w^L \right) \geq v^L - w^L$, since $v^H - v^L \geq d_S^H - d_S^L$ which is guaranteed by condition (2). That is, the firm can appropriate the efficiency gain, $v^H - v^L$, after paying the advanced-job, i.e. skilled, workers a compensation for their extra effort, $d_S^H - d_S^L$. In sum:

Lemma 1. *Assume that the advanced-jobs union's members are skilled. The firm and the advanced-jobs union agree on $w^H = \max \left\{ w_{NIC}^H, w_{IC}^H \left(w^L \right) \right\}$, given that the wage for basic jobs is given by $w^L \in \left[d_U^L, v^L \right]$.*

This best-reply function is illustrated by the thick line in figure 4a, assuming equal bargaining power. Clearly the wage for advanced jobs is always set in the interval

Figure 3: Best-reply functions

(a) Advanced jobs

(b) Basic jobs

$w^H \in \left[w_E^H, v^H \right]$. The details are relegated to Appendix A.

Negotiation with the basic-jobs union   Assume that the wage for advanced jobs is given by $w^H \in \left[w_E^H, v^H \right]$, as suggested above. Consider now the firm's negotiation with the basic-jobs union. I represent this negotiation by the asymmetric Nash bargaining solution. The union's objective is to maximize the wage premium, which is given by $w^L - d_U^L$, given that all workers in basic jobs are unskilled. The union's disagreement payoff is zero. The firm's objective is to maximize profit, which is given by $\pi = \lambda \cdot \left(v^L - w^L \right) + (1 - \lambda) \cdot \left(v^H - w^H \right)$ given that skilled workers are hired in advanced jobs and unskilled workers are hired in basic jobs. The firm's payoff in case of disagreement with the basic-jobs union is $(1 - \lambda) \cdot \left(v^H - w^H \right)$. The Nash product is then given by

$$N \left(w^H \right) = \left[\lambda \cdot \left(v^L - w^L \right) \right]^{1 - \beta} \cdot \left(w^H - d_S^H \right)^{\beta}$$

where $\beta \in [0, 1]$ is the union's bargaining power.

The task is to find the wage w^L that will be agreed by the firm and the basic-jobs workers, for any possible $w^H \in \left[w_E^H, v^H \right]$. This best-reply function is depicted in figure 4b. Given that the basic-jobs workers are unskilled, the firm and the union will agree on the wage splitting the surplus $S_L = v^L - d_U^L$ according to bargaining power, i.e. they will agree on

$$w_{NIC}^L = \beta \cdot v^L + (1 - \beta) \cdot d_U^L, \tag{12}$$

as long as this wage renders the wage schedule efficient. But if the wage for advanced jobs w^H is sufficiently low, w_{NIC}^L would induce skilled workers to migrate from advanced jobs to basic jobs. Then, w_{NIC}^L would actually not split the true surplus created by the agreement between the firm and the basic-jobs union equally. Therefore, the firm will be able to force the basic-jobs workers to agree on a wage below w_{NIC}^L. If w^H is moderately low, the basic-jobs workers will agree on the highest wage inducing the skilled workers to apply for advanced jobs, i.e.

$$w_{IC}^L \left(w^H \right) = - \left(d_S^H - d_S^L \right) + w^H. \tag{13}$$

Finally, there is a technical detail. If w^H is very low, the basic-jobs workers will not accept $w_{IC}^L \left(w^H \right)$. Instead there will be agreement on a slightly higher wage, $w_{ne}^L \left(w^H \right)$, defined in the Appendix. This "non-efficient wage" is illustrated by the segment of the best-reply function outside the efficient set in figure 4b. However, a wage schedule below IC_S cannot be an equilibrium since the firm and the advanced-jobs workers always have an incentive to raise w^H to satisfy the IC_S with equality. Therefore w_{ne}^L cannot be part of an equilibrium.

To sum up:

Lemma 2. *Assume that the basic-jobs union's members are unskilled. The firm and the basic-jobs union agree on $w^L = min \left\{ w_{NIC}^L, max \left\{ w_{IC}^L \left(w^H \right), w_{ne}^L \left(w^H \right) \right\} \right\}$, given that the wage for advanced jobs is given by $w^H \in \left[w_E^H, v^H \right]$.*

The formal derivation of the best-reply function is relegated to Appendix B.

Bargaining equilibrium   The remaining task is to combine the two best-reply functions to find the overall bargaining equilibrium, i.e. the Nash equilibrium in Nash bargaining solutions. To do so, I need to distinguish between two types of situations. The wage schedule $\left(w_{NIC}^H, w_{NIC}^L \right)$ is the equilibrium whenever this wage schedule satisfies the incentive compatibility constraint, i.e. $w_{NIC}^H - d_S^H \geq w_{NIC}^L - d_S^L$. This happens if, and only if,

$$r \leq \frac{\beta}{1 - \beta} \cdot \frac{1}{1 - \lambda} \cdot \triangle S \tag{14}$$

which may or may not hold under the assumptions previously made in this paper. Such a situation is depicted in figure 5a.
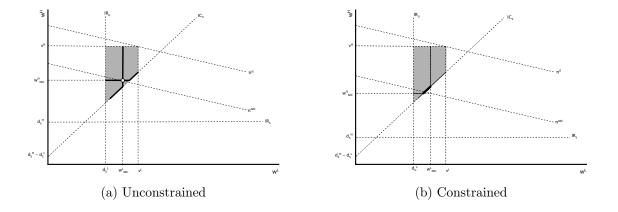
Figure 4: Crafts union equilibrium

| (a) Unconstrained | (b) Constrained |

If condition (14) is not satisfied, there exists a continuum of equilibrium wage schedules as depicted by the thick black line along the IC_S-line in figure 5b. That is, in case $\left(w_{NIC}^H, w_{NIC}^L\right)$ would induce skilled workers to apply for basic jobs, at least one wage will deviate from $\left(w_{NIC}^H, w_{NIC}^L\right)$ in equilibrium. Either the firm will agree to increase the wage of the advanced jobs, or the basic-jobs union will be forced to reduce their wage, or there will be a combination of these two concessions.

In sum:

Lemma 3. *Assume that skilled workers are organized in the advanced-jobs union and that unskilled workers are organized in the basic-jobs union. There always exists an equilibrium and every equilibrium wage schedule is efficient. The equilibrium wage schedule is given by $\left(w_{NIC}^H, w_{NIC}^L\right)$ if condition 14 is satisfied. Otherwise, any wage schedule $\left(w^H, w^L\right)$ such that*

$$w^H - w^L = d_S^H - d_S^L$$
$$w^H \geq w_{NIC}^H$$
$$w_{ne}^L \leq w^L \leq w_{NIC}^L$$

is an equilibrium.

It is not clear which equilibrium is most reasonable when condition 14 is not satisfied. But, as it turns out, it is not necessary to select any specific equilibrium for the purpose of this paper.
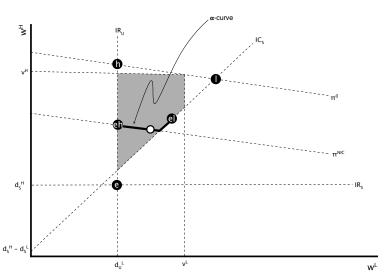
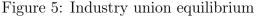## 4.3 Collective negotiations with an industry union

The current section analyzes wage bargaining when there is an industrial union organizing workers in both basic and advanced jobs. I assume that the union's wage policy (i.e. its

objective function) attaches a weight $\alpha \geq 0$ on the basic-job workers' wage premium and a weight $1 - \alpha \geq 0$ on the advanced-job workers' wage premium. That is, when the efficient outcome is implemented, the union's wage policy is described by[11]

$$U\left(w^H, w^L\right) = (1 - \alpha) \cdot \left(w^H - d_S^H\right) + \alpha \cdot \left(w^L - d_U^L\right).$$

Wages are determined through collective bargaining between the union and the firm. I represent this negotiation by the asymmetric Nash bargaining solution. The firm's objective is to maximize profit and the union's objective is to maximize $U\left(w^H, w^L\right)$. The disagreement payoff is zero for both the employer and the workers. The asymmetric Nash product is then given by $N\left(w^H, w^L\right) = \pi\left(w^H, w^L\right)^{1-\beta} \cdot U\left(w^H, w^L\right)^{\beta}$ where $\beta \in [0, 1]$ is the union's bargaining power. The bargaining outcome is found by maximizing the Nash product.

The equilibrium wage schedule which depends the union's wage policy (α) is illustrated by the α-curve in figure 5. When the union is biased in favor of the median worker, i.e.

Figure 5: Industry union equilibrium

$\alpha < \lambda$, the unique equilibrium is given by the eh-dot. When the union is unbiased, i.e. when the weights in the union's objective function coincides with the population shares $(\alpha = \lambda)$ any point on the bold part of the π^{NIC}-line is an equilibrium. When the union has egalitarian preferences, i.e. $\alpha > \lambda$, the unique equilibrium lies on the bold part of the IC-constraint. The higher α is, the further to the right is the equilibrium. With an extreme egalitarian wage policy, i.e. $\alpha = 1$, the equilibrium is given by the el-dot.

To understand this result, notice that the firm is willing to agree on any reallocation

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[11]A natural alternative formulation would be $U\left(w^H, w^L\right) = \left(w^H - d_S^H\right)^{1-\alpha} \cdot \left(w^L - d_U^L\right)^{\alpha}$. This formulation gives rise to the essentially same results, but in a slightly less transparent way.

of wages keeping the profit constant. That is, the firm is indifferent between any wage schedule along an iso-profit curve within the efficient set. If the union is unbiased ($\alpha = \lambda$), also the union does not have any preferences over different wage combinations on any given iso-profit curve. The exact wage schedule is therefore indeterminate.[12] The total wage bill is determinate, however, and is given by $(1 - \lambda) \cdot w_{NIC}^H + \lambda \cdot w_{NIC}^L$. All these wage schedules lie on the bold part of the π^{NIC}-line in figure 5. That is, the wage share is the same as under crafts unionism (when incentive-compatibility does not binding). This result is a simple restatement of Horn's and Wolinsky's finding. They consider a union maximizing the total wage bill and show that if the two groups of workers are neither complements nor substitutes, as is the case here, then an industry union and two crafts unions deliver the same total wage bill.

If the union is biased in favor of the median worker ($\alpha < \lambda$), the union wishes to maximize w^H on any iso-profit curve. Then, IR_U must bind in equilibrium, i.e. $w^L = d_U^L$. Maximizing the Nash product over w^H yields the same solution independent of $\alpha < \lambda$. The solution must therefore coincide with the solution when the union only cares about the skilled wage premium, $\alpha = 0$. The equilibrium wage schedule is illustrated by the eh-dot in figure 5, for the case when the bargaining rent is larger than the information rent ($\frac{1}{1-\lambda} \cdot \beta \cdot S > r$). It is straight-forward to demonstrate that, in this case, the total wage bill is given by $(1 - \lambda) \cdot w_{NIC}^H + \lambda \cdot w_{NIC}^L$.

If the union has egalitarian preferences ($\alpha > \lambda$), the union wishes to maximize w^L on any iso-profit curve. Thus, IC_S binds in equilibrium (assuming that the union's bargaining power is insufficient to capture the unskilled workers' total productivity). Thus, $w^H = w^L + \left(d_S^H - d_U^L\right) + r$, and the Nash product can be rewritten as

$$N\left(w^H, w^L\right) = \left[\tilde{S} - \left(w^L - d_U^L\right)\right]^{1-\beta} \cdot \left[\left(w^L - d_U^L\right) + (1 - \alpha) \cdot r\right]^{\beta},$$

where $\tilde{S} = S - (1 - \lambda) \cdot r$. Solving the first-order condition gives $w^L = d_U^L + \beta \cdot \tilde{S} - (1 - \beta) \cdot (1 - \alpha) \cdot r$ and w^H is given by the IC-constraint. With extreme egalitarian preferences, i.e. $\alpha = 1$, the equilibrium wage schedule is given by

$$\begin{aligned} w_{el}^L &= d_U^L + \beta \cdot S - \beta \cdot (1 - \lambda) \cdot r, \\ w_{el}^H &= d_S^H + \beta \cdot S - \beta \cdot (1 - \lambda) \cdot r + r. \end{aligned}$$

illustrated by the el-dot in figure 5. When the union's preferences are only slightly egalitarian, i.e. $\alpha \approx \lambda$, the total wage cost is approximately given by $(1 - \lambda) \cdot w_{NIC}^H + \lambda \cdot w_{NIC}^L$. This wage schedule lies on the IC-constraint slightly above the intersection with the π^{NIC}-

---

[12]The Nash product is given by $N\left(w^H, w^L\right) = \left[\lambda \cdot \left(v^L - w^L\right) + (1 - \lambda) \cdot \left(v^H - w^H\right)\right]^{1-\beta} \cdot \left[(1 - \lambda) \cdot \left(w^H - d_S^H\right) + \lambda \cdot \left(w^L - d_U^L\right)\right]^{\beta}$ and the first-order condition for both wages coincide and are given by $-\lambda(1 - \beta)\left[\lambda \cdot \left(v^L - w^L\right) + (1 - \lambda) \cdot \left(v^H - w^H\right)\right]^{-1} + \beta\lambda \cdot \left[(1 - \lambda) \cdot \left(w^H - d_S^H\right) + \lambda \cdot \left(w^L - d_U^L\right)\right]^{-1} = 0$.

line in figure 5. For intermediate cases, $\alpha \in (\lambda, 1)$, the equilibrium wage schedule lies on the bold part of the IC-constraint. A higher α leads to higher wages.

The intuition for why both premia and thus the total wage bill are increasing in α is simply that the union is weakened by considering the efficiency wage premium $r = d_U^L - d_S^L > 0$ as a gain in the negotiation. In the extreme case when $\alpha = 1$, the negotiation is, in effect, concerned with sharing a perceived surplus equal to $\tilde{S} = S - (1 - \lambda) \cdot r$ between a union receiving the unskilled premium $w^L - d_U^L$ and the employer receiving $\tilde{S} - \left(w^L - d_U^L \right)$. Since none of the parties care about the skilled workers' welfare they simply perceive the efficiency wage premium $(1 - \lambda) \cdot r$ as a cost of production that should be deducted from S. When $\alpha < 1$, however, the efficiency wage premium is part of the union's payoff.

In sum:

Lemma 4. *Assume that an industry union organizes all workers in both basic and advanced jobs. If condition (9) is satisfied, the firm and the union will agree on an efficient wage schedule. If $\alpha = \lambda$, any efficient wage schedule such that the total wage bill is given by $(1 - \lambda) \cdot w^H + \lambda \cdot w^L = (1 - \lambda) \cdot w_{NIC}^H + \lambda \cdot w_{NIC}^L$, is an equilibrium. If $\alpha < \lambda$, the equilibrium wage schedule is given by*

$$
\begin{aligned}
w^L &= w_{eh}^L = d_U^L, \\
w^H &= w_{eh}^H = d_S^H + \max\left\{ r, \tfrac{1}{1-\lambda} \cdot \beta \cdot S \right\}.
\end{aligned}
$$

If $\alpha > \lambda$, the equilibrium wage schedule is given by

$$
\begin{aligned}
w^L &= d_U^L + \beta \cdot \tilde{S} - (1 - \beta) \cdot (1 - \alpha) \cdot r, \\
w^H &= d_S^H + \beta \cdot \tilde{S} + r - (1 - \beta) \cdot (1 - \alpha) \cdot r.
\end{aligned}
$$

A formal proof is included in Stennek (2015).[13]

The industry-union's choice of wage policy   Before the collective bargaining starts, the members of an industrial union must decide what wage policy the union should pursue. The wage policy would be codified in official documents but also embodied in the members' choice of the union's leadership, e.g. the chief wage negotiator. Here, the wage policy is simply modeled as the union's objective function, describing how the union values the skilled and unskilled wages. The question is what weight α the union should attach to the unskilled workers' wage.

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[13]Condition (9) is needed to guarantee that the firm and the industry union would never choose a wage schedule that leads to unemployment among the unskilled workers. This condition is superfluous in the case of crafts unions since the union representing only the workers in basic jobs (the unskilled workers) would never agree on such an outcome.

As unions are democratic organizations, I assume that the wage policy is chosen to maximize the utility of the workers with median productivity. Clearly, if the unskilled workers would constitute the majority, an industry union would always pursue an egalitarian wage policy. But the evidence suggests that industrial unions emphasize the wages of low-productive *minorities*. To understand this phenomenon within a two-type model, I need to study the case when the median worker is skilled. For simplicity, I assume here that the skilled workers only care for their own wage premium and that they do not care for equity at all.

However, a wage negotiation is a strategic situation and the outcome is determined through the interaction between the firm and the union. As Schelling (1960) pointed out, even if union representatives are elected to maximize the utility of the median voter, the most effective representative need not share the principal's preferences.

Figure 6 describes the the equilibrium wage premium earned by the two skill-groups as
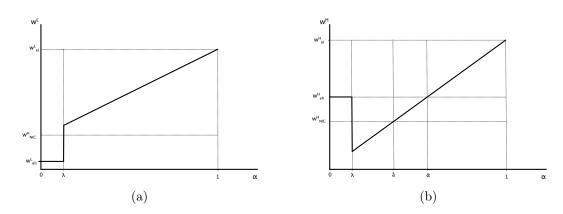
Figure 6: Equilibrium wages as functions of the industry union's equity concerns.

(a)   (b)

functions of the strength of the union's equity concern. Clearly, the more the union cares for the low-skilled workers, the (weakly) higher is their wage premium (figure 7a). More interestingly, the relation between the union's equity concerns and the skilled workers' wage premium is non-monotonic (figure 7b). For low levels of equity concerns, the skilled workers wage premium is (weakly) decreasing in equity concerns. In particular, the skilled workers wage premium jumps down when increasing α slightly above the threshold λ. After that, also the skilled workers' wage premium is increasing in α.

Thus a completely self-interested skilled worker prefers one of the two extreme policies. It is straight-forward to demonstrate that the wage in advanced jobs may be higher under an extreme egalitarian wage policy ($\alpha = 1$) than under a skill-biased wage policy ($\alpha = 0$). More precisely:

Lemma 5. *An industry union pursues an extreme egalitarian wage policy if, and only if,*

$$r > \theta \cdot \frac{1}{1 - \lambda} \cdot \beta \cdot S, \tag{15}$$
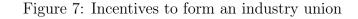
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where $\theta = \frac{\lambda}{1-\beta\cdot(1-\lambda)} < 1$. *Otherwise, the union pursues a skill-biased policy.*
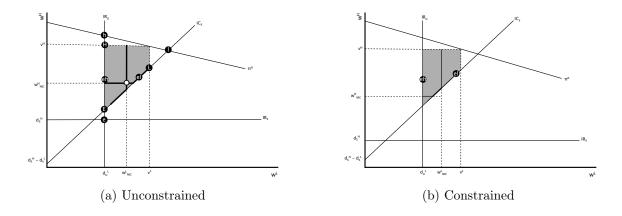
This result is illustrated by the fact that the el-dot is above the eh-dot in figure 5. Inequality 15 is also assumed to hold in figure 6.[14]

5 Union formation

Before the collective wage negotiations begin, the workers have to organize. I assume that all skilled workers join the same union and that all unskilled workers join the same union, thus disregarding any collective action problems within the groups. Therefore, there will either be an industry union organizing all workers, independent of what job they have, or two separate crafts unions, one representing the workers in advanced jobs and the other representing the workers in basic jobs. I assume that there will only be an industry union if both types of workers prefer to join such a union to separate unions.

Consider first the possibility that collective negotiations with separate crafts unions would result in an unconstrained equilibrium, as described by the circle in figure 8a. In

Figure 7: Incentives to form an industry union

| (a) Unconstrained | (b) Constrained |

case an industry union would pursue a skill-biased wage policy, i.e. $\alpha < \lambda$, it would only grant the unskilled workers a compensation for their disutility of work, as described by the eh-dot. A separate crafts union, on the other hand, would grant the unskilled workers a share of the surplus they produce. Thus:

$$w^L_{eh} < w^L_{NIC}. \tag{16}$$

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[14]Stennek (2015) includes equity concerns. It is demonstrate that the skilled workers prefer an extreme egalitarian wage policy if and only if the efficiency wage premium is large enough compared to the direct bargaining premium. The more the skilled workers are concerned with equity, the lower is the requirement on the efficiency wage premium.

It follows immediately that the unskilled workers would not agree to form an industry union that would set $\alpha < \lambda$.

In case an industry union would pursue an egalitarian wage policy, i.e. $\alpha > \lambda$, the unskilled workers get a higher wage than under crafts unionism. For example, in the extreme case when $\alpha = 1$, the unskilled workers can use the combined bargaining strength of both groups to raise the wage in basic jobs. Then,

$$w_{el}^L > w_{NIC}^L \tag{17}$$

as indicated by figure 8a.

What about the skilled workers? Recall that under the condition for strategic delegation (15), skilled workers want an industry union to pursue an egalitarian wage policy, i.e. $w_{el}^H > w_{eh}^H$. Also note that the skilled workers would get a higher wage by using the combined strength of all workers than by bargaining separately, i.e. $w_{eh}^H > w_{NIC}^H$. Geometrically this follows from the fact that the eh-dot is the midpoint between the e-dot and the h-dot while w_{NIC}^H is the midpoint between the e-dot and the H-dot. Taken together these inequalities imply that skilled workers prefer an industry union pursuing an egalitarian wage policy over separate unions, i.e.

$$w_{el}^H > w_{NIC}^H. \tag{18}$$

Thus all workers have an incentive to form an industry union, when such a union would pursue an egalitarian wage policy.

Actually the same results follow also in case separate unions would lead to some "constrained equilibrium" described by the points on the thick line in figure 8b. Note that both skilled and unskilled workers prefer an industry union pursuing an extreme egalitarian wage policy to separate unions even if the most favorable equilibrium, i.e. $w^L = w_{NIC}^L$ and $w^H = w_{IC}^H \left(w_{NIC}^L \right)$, would be selected. Also note that unskilled workers would reject an industry union with $\alpha < \lambda$.[15]

Thus:

Proposition 1. *An industry union is formed if, and only if, it would pursue an egalitarian wage policy.*

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[15]One might argue that the workers have an additional reason to form an industry union in case separate unions would lead to a constrained equilibrium. It seems plausible that the firm which is represented in both negotiations may have a strategic advantage in coordinating expectations on one of the equilibria. They would then clearly choose the equilibrium with the lowest wage bill, i.e. $w^H = w_{NIC}^H$ and $w^L = w_{IC}^L \left(w_{NIC}^H \right)$, as figure 8b is drawn. An industry union would eliminate any such strategic advantage that the firm might enjoy with separate negotiations. (Even with this effect in mind, the unskilled workers would still not agree to a median-wage maximizing union.)

The reason is that the workers in basic jobs prefer separate crafts unions, unless an industry union would pursue an egalitarian wage policy. Thus, an egalitarian wage policy is not only what an industry union will pursue but also part of the reason why such egalitarian industry unions exist in the first place.

There is, however, an imperfection in the unionization process, from the workers' point of view. By asking for too much, the workers in advanced jobs may end up with less. In particular, recall that the workers in basic jobs always prefer an egalitarian industry union to crafts unions. Also the workers in advanced jobs would prefer an industry union pursuing an egalitarian wage policy to a crafts union equilibrium (i.e. $w_{el}^H > w_{NIC}^H$) if, and only if, the information rent is sufficiently large,[16]

$$r > \underline{r}(\beta) \equiv \frac{\lambda}{1-\lambda} \cdot \frac{\beta}{1-\beta} \cdot \triangle S \geq 0.$$

Recall, however, that the workers in advanced jobs would impose a median-wage policy, rather than an egalitarian wage policy, in case an industry union is actually formed (i.e. $w_{eh}^H > w_{el}^H$) if, and only if, the information rent is sufficiently small,

$$r < \overline{r}(\beta) \equiv \frac{1-\beta}{1-\beta \cdot (1-\lambda)} \cdot \frac{\lambda}{1-\lambda} \cdot \frac{\beta}{1-\beta} \cdot S.$$

But, then, crafts unions are formed, since the workers in basic jobs would not join such an industry union. Thus:

Proposition 2. *The workers form crafts unions, even though they would all be better off with an industry union pursuing an egalitarian wage policy if, and only if, the information rent is moderate, $r \in (\underline{r}(\beta), \overline{r}(\beta))$, and union bargaining power is sufficiently low,*

$$\beta < \frac{1 - \frac{\triangle S}{S}}{1 - (1-\lambda) \cdot \frac{\triangle S}{S}}. \tag{19}$$

Low bargaining power (inequality 19) is necessary and sufficient for $\underline{r}(\beta) < \overline{r}(\beta)$.

It may be possible to somewhat reduce the discretionary powers of the majority through the union charter, i.e. through the allocation of decision rights agreed when the union is formed. Wage agreements may e.g. be subject to unanimous ratification by a broadly composed board. But there are limits to how representative a board can be made. And it is the union leadership that meets with the firm. The leadership has the initiative and also more information about what can be achieved for the different skill-groups in

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[16]To prove this inequality, note first that if the crafts unions equilibrium would be constrained, i.e. $r > \frac{1}{1-\lambda} \cdot \frac{\beta}{1-\beta} \cdot \triangle S$, the workers in advanced jobs would always be better off with an industry union pursuing an egalitarian wage policy than they are with separate unions. Note, second, that in case the crafts unions equilibrium would be unconstrained, i.e. $r \leq \frac{1}{1-\lambda} \cdot \frac{\beta}{1-\beta} \cdot \triangle S$, the workers in advanced jobs would be better off with an industry union pursuing an egalitarian wage policy than they are with separate unions (i.e. $w_{el}^H > w_{NIC}^H$) if, and only if, $r > \frac{\lambda}{1-\lambda} \cdot \frac{\beta}{1-\beta} \cdot \triangle S$.

the negotiation. Absent a common interest, the least productive minority is thus at a disadvantage in an industry union; a separate union may be preferred.

An industry union would also not be able to compensate the skilled workers for accepting an egalitarian wage policy in case such a policy would increase the total wage share but reduce the wage in advanced jobs. Even if side-payments would be possible, they would weaken the IC_S-constraint. That is, with side-payments, the firm may not need to maintain the same wage differences to induce the skilled workers to select the more advanced jobs. Then the whole efficiency gain from an egalitarian wage policy disappears.

6 Effect of unions on wages

It is now time to study the effect of unions on wages and to relate the theoretical results to the empirical literature. Thus, the present section compares the equilibrium wages when unions are present ($\beta > 0$) with the equilibrium wages when unions are absent ($\beta = 0$). Absent unions, the employer sets the wages at $w_E^L = d_U^L$ and $w_E^H = d_U^L + \left(d_S^H - d_S^L\right)$ and the wage difference is $w_E^H - w_E^L = d_S^H - d_S^L$.

An industry union always decreases wage inequality. To see this notice that an industry union is formed given that it pursues an egalitarian wage policy. The equilibrium wages are thus given by $w_{el}^L = d_U^L + \beta \cdot \tilde{S}$ and $w_{el}^H = d_S^H + r + \beta \cdot \tilde{S}$. Note that the skilled wage is higher than the unskilled wage absent unions ($\beta = 0$). In particular, $d_S^H + r > d_U^L$ follows from $d_S^H > d_S^L$. The effect of an industry union ($\beta > 0$) is to increase both wages by the same amount. It follows that an industry union increases the unskilled wage more than the skilled wage in percentage terms. Expressed differently, the relative wage ($\frac{w^H}{w^L}$) is reduced. (The relative wage, i.e. the difference in log-wages, is typically the focus of empirical studies.)[17]

Proposition 3. *An industry union increases all wages and reduces wage inequality.*

This proposition may help to interpret the stylized facts about the wage effects of unionism referred to in the introduction.

When crafts unions are formed and the incentive-compatibility constraint does not bind, i.e. when $\beta \cdot \triangle S > (1 - \beta) \cdot (1 - \lambda) \cdot r$, the equilibrium wages are given by $w_{NIC}^L = d_U^L + \beta \cdot \left(v^L - d_U^L\right)$ and $w_{NIC}^H = d_S^H + \beta \cdot \left(v^H - d_S^H\right)$. It is easy to see that both wages are increased and that wage inequality, in absolute terms, is increased, since

$$\left(w_{NIC}^H - w_{NIC}^L\right) - \left(w_E^H - w_E^L\right) = \beta \cdot \frac{1}{1 - \lambda} \cdot \triangle S - (1 - \beta) \cdot r > 0.$$

Numerical examples reveal that the relative wage ($\frac{w^H}{w^L}$) may be increased. When the

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[17]Stennek (2015) demonstrates that the unskilled wage is increased more than the skilled wage also in absolute terms, when unemployment is taken into account.

incentive compatibility constrain binds in equilibrium, the effect of unions is to increase both wages by the same amount. The relative wage is then reduced.

Proposition 4. *Crafts unions increase all wages and may increase or decrease wage inequality.*

Taken together, these propositions suggest that it is desirable to condition empirical studies of unions on their organizational form. They also provide a possible interpretation of the pattern discovered by Ozanne (1962) in a study based on data for one particular firm (a farm machine company) over the period 1858 to 1958. During this period the workers were organized by many different unions. Skill differentials narrowed during some and widened during other regimes. Most interestingly, there was a general tendency for industrial unions to lower skill differentials and for craft unions to raise them.

7   Collective bargaining over minimum wages

In large parts of Europe minimum wage levels are set through collective negotiations. These negotiations occur at the national level between national unions and employers' confederations, either industry by industry or for the country as a whole. In some countries the collectively negotiated minimum wage is later established as law.[18]

In the wake of the economic crisis there has been some political pressure to lower minimum wages especially in Greece but also in other European countries including Sweden. To understand what role minimum wages play in Europe, it is vital to first understand how they are determined through the collective negotiations between the employers and the unions. Unfortunately, however, almost all research on minimum wages concern countries such as the United States and Canada where minimum wages levels are determined by lawmakers (Neumark and Wascher, 2007). The present model can be reinterpreted and viewed as a first attempt to fill this gap.

Collective bargaining at the national level   In a system with central collective bargaining, national (or industry) negotiations precede local negotiations. The degree of centralization varies depending on how detailed the central agreement is and how much is delegated to the local negotiations. But to concentrate on the role of the minimum wage, I assume that all other issues are decided locally. I assume that the central organizations can foresee how the local wages are set, depending on what minimum wage they agree

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[18]Collective bargaining is the dominant mode in Italy, Germany, Austria and the Nordic countries. There, minimum wages are negotiated on an industry-by-industry basis. Also in Belgium, Greece, Estonia, Poland and the Czech Republic the minimum wage levels are negotiated between the labor market parties. But in these countries the agreed minimum wages are subsequently established as law, applicable for the economy as a whole. Also in e.g. Ireland, Portugal and Spain the labor market parties play a role in the determination of the legal minimum wage. See Skedinger (2012) for a closer description.

upon. This assumption is supported by Hibbs' and Locking's (1996) finding that local wage drift is accurately predicted and fully incorporated into central agreements. Since I am interested in wage inequality at the firm level, I assume that all firms are identical and that the central negotiation is conducted by an employers' confederation which simply maximizes the profit of the representative firm.

In order for the central negotiation to matter, the unions' bargaining power must be higher at the national level than it is at the local level. One reason why this may be so is that wage costs are "taken out" of product market competition in central negotiations. Another reason is that the parties are not permitted to resort to industrial actions (e.g. strikes and lock-outs) during the term of the central agreement. Here, however, I will simply assume that the union has some bargaining power at the central level ($\beta > 0$) but that the employers can set wages unilaterally at the local level.

Thus, the model has two periods. First, the labor market parties agree on a minimum wage ($\underline{w}$) at the national level. Second, the local employers maximize profits by setting wages (w^L and w^H) subject to the minimum wage.

In the second period, assuming that $\underline{w} \geq d_U^L$, the firms set the wage for basic jobs at the minimum wage, i.e. $w^L = \underline{w}$, and the wage for advanced jobs according to the incentive compatibility constraint, i.e. $w^H = \underline{w} + \left(d_S^H - d_S^L\right)$. Assuming that the national union maximizes the utility of the lowest paid workers ($\alpha = 1$), national bargaining over the minimum wage is represented by the Nash product $N_L\left(\underline{w}\right) = \left[\lambda \cdot v^L + (1 - \lambda) \cdot v^H - \underline{w} - (1 - \lambda) \cdot r\right]^{1-\beta} \cdot \left[\underline{w} - d_U^L\right]^{\beta}$. Using the incentive constraint, the Nash product can be rewritten as
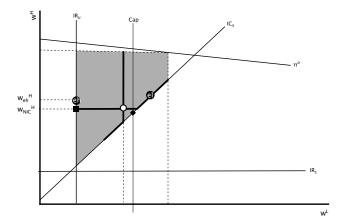
$$N_L\left(\underline{w}\right) = \left[\tilde{S} - \left(\underline{w} - d_U^L\right)\right]^{1-\beta} \cdot \left[\underline{w} - d_U^L\right]^{\beta},$$

which is exactly the same bargaining problem as above (see expression **??**). The above solution can therefore be reinterpreted as the outcome of collective bargaining over minimum wages at the national level.

A cap on minimum wages To assess the consequences of a cap on minimum wages, consider figure 8. Absent the cap, an industry union pursuing an egalitarian wage policy is formed. The outcome is represented by the el-dot.

Consider first the effects of a "non-drastic" cap $\hat{w} \in \left(IC_S^L\left(w_{eh}^H\right), w_{el}^L\right)$. Then, the equilibrium outcome is given by the intersection of the cap and the IC_S-constraint. It follows that both wages are lower than absent the cap (the el-dot) and that a tighter cap moves the equilibrium down from the el-dot along the IC_S-constraint.

Consider second the effects of a "drastic" cap $\hat{w} < IC_S^L\left(w_{eh}^H\right)$. Then $IC_S^H\left(\hat{w}\right) < w_{eh}^H$. For example, under the cap represented by a vertical line in figure 8, an industry union pursuing an egalitarian wage policy can only achieve the wage schedule represented by the black diamond. In such a case, the skilled workers prefer not to pursue an egalitarian

Figure 8: A cap on the minimum wage

wage policy (if it is strategically motivated). But then, crafts unions will be formed in equilibrium.

Proposition 5. *A cap on collectively negotiated minimum wages implies that all wages are lower. If the cap is sufficiently low, crafts unions are formed instead of an industry union.*

Consider now an economy with an industry union pursuing an egalitarian wage policy. Assume that a drastic cap on minimum wages is suddenly imposed. Then, in the short run, the whole equilibrium wage schedule is lowered from the el-dot to the black diamond. Such a policy amounts to a so-called "internal devaluation," i.e. a reduction of all blue-collar wages. In the medium run, the industry union will, however, give up its egalitarian wage policy. The wage schedule is moved from the black diamond to the eh-dot. The gist of this change is to redistribute wages from the low skilled to the high skilled workers. In the long run, the unskilled workers form a separate union. The wage schedule represented by the circle is the new long-run equilibrium.[19] Thus, a cap on minimum wages does not only restrict the outcome of the collective negotiation. It has the potential to change union goal-setting and even the pattern of unionization.

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[19]It is possible that there are frictions that may delay the transformation of the organizational structure. At first, individual low-skilled workers may simply leave the industry union, to avoid the union dues. During this period while the low-skilled workers remain unorganized the equilibrium wage schedule moves from the eh-dot towards the black square, gradually lowering the skilled wage. Then, the formation of a new crafts union may be plagued by a collective action problem. It is also possible that the old industry union would resist the formation of the new union by requiring exclusivity in negotiating collective agreements.

8 Extensions

8.1 High-productive minorities

Since the purpose of this paper is to understand why some unions appear to favor their least productive minorities, I have focused on the interaction between the union majority and a low-productive minority. It also turns out that the relation between the majority and a high-productive minority is less problematic. I will illustrate this point within the simple two-type model already developed. When there is a minority of high-productive workers and a majority of low-productive workers, the only change to the model is that $\lambda > \frac{1}{2}$.

A first observation is that an industry union would always pursue an egalitarian wage policy and never a skill-biased wage policy. Thus, with an industry union, the skilled workers earn

$$w_{el}^H = d_S^H + r + \beta \cdot [S - (1 - \lambda) \cdot r].$$

Note, however, that also the high-productive minority is guaranteed a part of the surplus. In addition to $w_E^H = d_S^H + r$, they receive the same bargaining premium as the median-productive workers (the third term on the right hand side). Thus, as a result of the incentive compatibility constraint, a high-productive minority is never exposed to the same degree of ex post opportunism by the majority as low-productive workers may be.

A second observation is that an industry union is also more easily formed when the unskilled workers are in majority. Then, an industry union is formed if, and only if, $w_{el}^H > w_{NIC}^H$. In contrast, when the skilled workers are in majority, an industry union is formed if, and only if, both $w_{el}^H > w_{NIC}^H$ and $w_{el}^H > w_{eh}^H$. Since $w_{eh}^H > w_{NIC}^H$, the condition for industrial unionism is stricter in this case.

8.2 White-collar workers

The analysis may be extended to take into account that blue-collar workers compete with white collar-workers for wages. Since the overall wage cost affects firms' pricing and output decisions also the employment level is affected. Thus there is an employment externality between the blue- and the white-collar workers. If one group succeeds to increase its wage level, demand for the other group is reduced, as blue- and white collar workers are complements in production. The results show that if the blue-collar union adopts an egalitarian wage policy (e.g. for strategic reasons) it will not only increase the wages of all blue-collar workers, but it may also reduce the wages of white-collar workers. Thus, the blue-collar union's egalitarian wage policy does not only reduce wage inequality between skilled and unskilled blue-collar workers, but also the wage difference between blue- and white collar workers. These results are consistent with Freeman's (1980) findings. I also demonstrate that blue-collar unions are more inclined to pursue an egalitarian wage policy

when part of the increased wage-cost is carried by the white-collar workers rather than the employers.

An additional implication is that while a cap on minimum wages may reduce all blue-collar workers wages, as demonstrated in the present paper, the total wage cost may not be reduced by much, since white-collar wages may be increased when blue-collar wages are reduced.

9 Concluding remarks

According to Kaufman (2002), the fundamental weak spot of the theory of trade unions is our understanding of the unions' goals and how these goals relate to both the institutional structure of the unions and to the collective bargaining process itself. The empirical literature suggests that unions have egalitarian preferences. In Stennek (2015) I argue that the conflict between workers of different skills may have been exaggerated. Fighting for the lowest wages may be an efficient strategy for industry unions to increase the wages of all their members. In the present paper, I extend this analysis to show that an egalitarian wage policy may also be a necessary and sufficient condition for workers of different skills to unite. Thus, an egalitarian wage policies is not only what industry unions do, but also part of the reason why they exist in the first place.

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A   Negotiation with skilled workers

To prove this claim, the Nash product has to be defined, assuming that $w^L \in \left[d_U^L, v^L\right]$. If the employers and the skilled workers agree on some wage w^H that satisfies the IC- and right-to-manage constraints, $w^H \in \left[w_{IC}^H\left(w^L\right), v^H\right]$, the skilled workers will apply for difficult jobs. If not, they will apply for basic jobs (since $w^L \geq d_U^L < d_S^L$). Therefore the skilled workers' utility is given by

$$U_H = \begin{cases} w^H - d_S^H & if\ w^H \in \left[w_{IC}^H\left(w^L\right), v^H\right] \\ w^L - d_S^L & otherwise \end{cases}$$

and the employer's profit is given by

$$\pi = \begin{cases} \lambda \cdot \left(v^L - w^L\right) + (1 - \lambda) \cdot \left(v^H - w^H\right) & if\ w^H \in \left[w_{IC}^H\left(w^L\right), v^H\right] \\ v^L - w^L & otherwise \end{cases}$$

The employer's profit increase from agreeing with the skilled workers is thus

$$\Delta_H \pi = \begin{cases} (1 - \lambda) \cdot \left(v^H - w^H\right) & if\ w^H \in \left[w_{IC}^H\left(w^L\right), v^H\right] \\ (1 - \lambda) \cdot \left(v^L - w^L\right) & otherwise \end{cases}$$

and the Nash product is given by

$$N_H = \Delta_H \pi \cdot U_H = \begin{cases} \left[(1 - \lambda) \cdot \left(v^H - w^H\right)\right]^{1-\beta} \cdot \left(w^H - d_S^H\right)^{\beta} & if\ w^H \in \left[w_{IC}^H\left(w^L\right), v^H\right] \\ \left[(1 - \lambda) \cdot \left(v^L - w^L\right)\right]^{1-\beta} \cdot \left(w^L - d_S^L\right)^{\beta} & otherwise \end{cases}$$

Both parties prefer an efficient wage w^H to a non-efficient outcome if it satisfies

$$w^H - d_S^H \geq w^L - d_S^L$$
$$v^H - w^H \geq v^L - w^L$$

that is
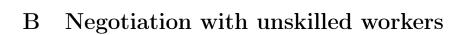
$$w^H \geq \left(d_S^H - d_S^L\right) + w^L$$
$$w^H \leq \left(v^H - v^L\right) + w^L$$

Such a mutually preferred efficient wage always exists since $v^H - v^L \geq d_S^H - d_S^L$ by inequality (2). Therefore, if the unconstrained maximization of N_H yields a non-efficient wage-structure, given w^L, i.e. if

$$w_{NIC}^H < w_{IC}^H\left(w^L\right)$$

the employers and the skilled workers will agree on the higher wage $w_{IC}^H\left(w^L\right)$ that satisfies the IC-constraint with equality. An even higher wage will not be considered since that would reduce the (unconstrained) Nash product even further, as depicted by the figure.

Figure 9: Advanced jobs Nash product

B   Negotiation with unskilled workers

Assume that $w^H \in \left[w_E^H, v^H\right]$ and note that the firm and the union for basic jobs would never agree on a wage outside the interval $w^L \in \left[d_U^L, v^L\right]$, as such wages would make the unskilled workers unemployed (recall that d_U^H is extremely high) without changing the skilled workers' incentives.

If the employers and the unskilled workers agree on some wage $w^L \in \left[d_U^L, v^L\right]$ for basic jobs, the unskilled workers' utility is given by

$$U_L = w^L - d_U^L.$$

Define the wage satisfying the IC_S-constraint with equality as

$$w_{IC}^L\left(w^H\right) = -\left(d_S^H - d_S^L\right) + w^H.$$

If the agreed wage satisfies the IC_S-constraint, i.e. $w^L \leq w_{IC}^L\left(w^H\right)$, the skilled workers will apply for difficult jobs. If not, they will apply for basic jobs. Therefore the employer's profit is given by

$$\pi = \begin{cases} \lambda \cdot \left(v^L - w^L\right) + (1-\lambda) \cdot \left(v^H - w^H\right) & \text{if } w^L \leq w_{IC}^L \\ v^L - w^L & \text{otherwise} \end{cases}$$

The employer's profit increase from agreeing with the skilled workers is thus

$$\Delta_L \pi = \begin{cases} \lambda \cdot \left(v^L - w^L\right) & \text{if } w^L \leq w_{IC}^L \\ \lambda \cdot \left(v^L - w^L\right) + (1-\lambda) \cdot \left[\left(v^L - w^L\right) - \left(v^H - w^H\right)\right] & \text{otherwise} \end{cases}$$

The Nash product is given by

$$N_L = \begin{cases} \left(w^L - d_U^L\right)^\beta \cdot \left[\lambda \cdot \left(v^L - w^L\right)\right]^{1-\beta} & \text{if } w^L \leq w_{IC}^L \\ \left(w^L - d_U^L\right)^\beta \cdot \left(\left(v^L - w^L\right) - (1-\lambda) \cdot \left(v^H - w^H\right)\right)^{1-\beta} & \text{otherwise} \end{cases}$$

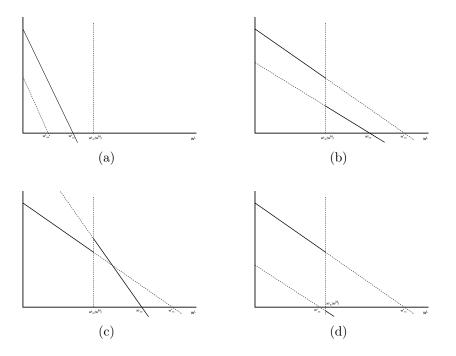To simplify notation, it is assumed that $\beta = 1/2$. Then, the first derivative is given by

$$\frac{\partial N_L}{\partial w^L} = \begin{cases} \lambda \cdot \left(v^L + d_U^L - 2w^L\right) & \text{if } w^L \leq w_{IC}^L \\ \left(v^L + d_U^L - 2w^L\right) - (1-\lambda) \cdot \left(v^H - w^H\right) & \text{otherwise} \end{cases}$$

The derivative is monotonically decreasing in w^L except at w_{IC}^L where the derivative jumps up (see figure 11c) or down (see figure 11b), depending on the circumstances.

Note that the "upper part" of the Nash product takes on an unconstrained maximum at

$$w_{NIC}^L = \frac{v^L + d_U^L}{2}$$

Clearly w_{NIC}^L is a local maximum of the Nash product if, and only if, $if\ w_{NIC}^L \leq w_{IC}^L$. The "lower part" of the Nash product (corresponding to a non-efficient outcome) takes on

Figure 10: First-Order Condition

(a)

(b)

(c)

(d)

an unconstrained maximum at

$$w_{ne}^L = \frac{v^L + d_U^L}{2} - \frac{(1-\lambda) \cdot (v^H - w^H)}{2}$$

Clearly w_{ne}^L is a local maximum of the Nash product if, and only if, $w_{IC}^L \le w_{ne}^L$, i.e. if

$$w^H \le \frac{2}{1+\lambda} \left[\frac{v^L + d_U^L}{2} + \left(d_S^H - d_S^L\right) - \frac{(1-\lambda) \cdot v^H}{2} \right].$$

Moreover, since $w^H \le v^H$ it follows that $w_{ne}^L \le w_{NIC}^L$. There are then three possibilities

1. $w_{ne}^L \le w_{NIC}^L \le w_{IC}^L$

2. $w_{ne}^L \le w_{IC}^L \le w_{NIC}^L$

3. $w_{IC}^L \le w_{ne}^L \le w_{NIC}^L$

In the first case w_{NIC}^L but not w_{ne}^L is a local maximum of the Nash product. As revealed by figure 11a, w_{NIC}^L is then also the unique global maximum. In the third case w_{ne}^L but not w_{NIC}^L is a local maximum of the Nash product. As revealed by figure 11b and figure 11c, w_{ne}^L is then also the unique global maximum. In the second case, neither w_{NIC}^L nor w_{ne}^L is a local maximum. As revealed by figure 11d, w_{IC}^L is then the unique global maximum.

In sum, the optimal wage is given by

$$w^L = \begin{cases} w^L_{NIC} & & w^L_{NIC} \leq w^L_{IC} \\ w^L_{IC} & \text{if} & w^L_{IC} \in \left[w^L_{ne}, w^L_{NIC}\right] \\ w^L_{ne} & & w^L_{IC} \leq w^L_{ne} \end{cases}$$

Since w^L depends on w^H we need to think about this relationship as a best-reply function. This best-reply function is illustrated in the figure in the main text.