Strategic Union Delegation and Strike Activity[*]

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Abstract

We develop a model of wage determination with private information, in which the union has the option to delegate the wage bargaining to either surplus-maximizing delegates or to wage-maximizing delegates (such as senior union members). We show that the strike activity is greater whenever the union chooses wage-maximizing delegates instead of surplus-maximizing delegates. We also provide the necessary and sufficient condition such that it is always optimal for the union to choose wage-maximizing delegates and we find that the efficiency loss due to strategic delegation may be quite important.

Keywords: Union delegation, Wage bargaining, Private information, Strike activity.

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1 Introduction

The purpose of this paper is to provide a theoretical study of how the option for unions to delegate the wage bargaining will affect the wage outcome and the incentives for strikes. Up to now the literature has mainly focused on strategic delegation on behalf of shareholders. Fershtman and Judd (1987) have addressed the issue of strategic managerial delegation in the context of oligopolistic industries with Cournot competition (see also Sklivas, 1987). Regarding strategic union delegation, Jones (1989) has shown that a divergence between the objectives of union leaders and union members will naturally arise in a democratic union as part of a rational bargaining strategy. Essentially, the reason is that in many bargaining situations, commitment can be valuable, and the union members can credibly commit to a bargaining stance, which they could not otherwise sustain, by delegating authority to a negotiator whose objectives make this stance an optimal one. More recently, Conlin and Furusawa (2000) have provided an explanation of why senior union members may represent the union in contract negotiations with a monopolist. By strategically delegating contract negotiations to wage-maximizing individuals, the surplus-maximizing union may be better off than if surplus-maximizing individuals negotiate the contract.

But these previous studies have considered complete information frameworks so that strikes, which waste industry resources, cannot occur at equilibrium.[1] So, we go beyond the analysis offered in Jones (1989) and Conlin and Furusawa (2000) by developing a model that enable us to investigate in presence of strategic union delegation how private information affects the wage level and the efficiency loss due to the strike activity.[2]

Precisely, we develop a model of wage determination in which both the union and the firm have private information. First, the union chooses whether to use surplus-maximizing delegates or to use wage-maximizing delegates (such as senior union members) who will negotiate the wage with the employer. Second, the wage bargaining occurs. To describe the wage bargaining process, we adopt Rubinstein's (1982) alternating-offer bargaining model with two-sided incomplete information, which allows the occurrence of strikes at equilibrium. Finally, the firm chooses its output level to be produced.

As a benchmark we first consider the complete information situation and we show that, the weaker the union is, the more likely the union will choose to send wage-maximizing delegates. The choice of wage-maximizing delegates always increase the wage level and decreases the production output (and the employment level) as well as the consumer surplus.

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

[2] See Kennan and Wilson (1989, 1993) for surveys of bargaining models with private information and their relation to strike data. See Kennan (1986) for a survey of the empirical results on strike activity.

Once the negotiators have private information, the complete information results are not always valid. For example, it might be that the wage outcome in case of surplus-maximizing delegates is greater than the wage outcome in case of wage-maximizing delegates. However, if it is commonly known that union is stronger than the ¯rm and the labor demand is quite elastic, then we recover the complete information result, namely that the wage outcome in case of surplus-maximizing delegates is always strictly smaller than the wage outcome in case of wage-maximizing delegates.

Finally, we show that the strike activity is greater whenever the union chooses wage-maximizing delegates instead of surplus-maximizing delegates. We provide the necessary and su±cient condition such that, even in presence of private information, it is always optimal for the union to choose wage-maximizing delegates. We ¯nd that the strategic delegation can increase quite substantially the e±ciency loss due to the strike activity.

The paper is organized as follows. In Section 2 the model is presented. Section 3 describes the wage bargaining game and choice of delegates under complete information. Section 4 is devoted to the wage bargaining with private information. Section 5 o®ers some predictions regarding the actual strike duration and the e±ciency loss incurred during wage negotiations. Finally, Section 6 concludes.

2 The Basic Model

Consider a market for a single homogenous product, where the demand is given by $P = a ¡ b¢Q^c$, P is the market price, Q is the quantity produced, and $c > 0$. There is one ¯rm producing the good. Let ¦ denote the pro¯t level. The only variable input is labor. Technology exhibits constant returns to scale and is normalized in such a way that $Q = L$, where L is labor input, and the unit production cost of each ¯rm is the wage W. Thus, the pro¯t of each ¯rm is given by

$$¦ = (a ¡ bQ^c)Q ¡ WQ. \qquad (1)$$

The ¯rm belongs to and is controlled by one risk-neutral owner whose objective is to maximize pro¯ts. In addition, the ¯rm is unionized, and enters into a closed-shop agreement with its risk-neutral union. The union objective is to maximize the union surplus:

$$U = L(W ¡ \overline{W}), \qquad (2)$$

where $\overline{W}$ is the reservation wage. The wage rate is determined by negotiations between the ¯rm and the union delegates. Preceding the negotiations, the union may a®ect the negotiation outcome by selecting delegates whose objective is either to maximize the union's surplus or to maximize the wage rate.

We develop a three-stage game. In stage one, the surplus-maximizing union chooses whether to use surplus-maximizing delegates or to use wage-maximizing delegates (such as senior union members) who will negotiate the wage with the employer. The objective of a wage-maximizing delegate is simply $V = W - \overline{W}$. In stage two, the wage bargaining occurs. Finally, in stage three the employer chooses the output level. The model is solved backwards.

In the last stage of the game, knowing that the wage level (W) has already been determined, the employer chooses

$$Q(W) = \left[\frac{a - W}{(1+c)b}\right]^{\frac{1}{c}} \tag{3}$$

to maximize its profits. In stage two, the negotiation takes place. We first consider the complete information bargaining as a benchmark.

3 The Wage Bargaining with Complete Information

First, we consider the case in which the union sends surplus-maximizing delegates whose interest is the same as the union's objective. The negotiation proceeds as in Rubinstein's (1982) alternating-offer bargaining model. The firm and the union delegates make alternatively wage offers, with the firm making offers in odd-numbered periods and the union delegate making offers in even-numbered periods. The length of each period is Δ. The negotiation starts in period 0 and ends when one of the negotiators accepts an offer. No limit is placed on the time that may be expended in bargaining and perpetual disagreement is a possible outcome. The union is assumed to be on strike in every period until an agreement is reached. Both the firm and the union are assumed to be impatient. The firm and the union delegate have time preferences with constant discount rates $r_f > 0$ and $r_u > 0$, respectively.[3]

To capture the notion that the time it takes to come to terms is small relative to the length of the contract, we assume that the time between periods is very small. This allows a study of the limiting situations in which the bargaining procedure is essentially symmetric and the potential costs of delaying agreement by one period can be regarded

[3] Two versions of Rubinstein alternating-offer bargaining model capture different motives that induce parties to reach an agreement rather than to insist indefinitely on incompatible demands. In a first version the parties' incentive to agree lies in the fact that they are impatient : player i is indifferent between receiving $x \cdot \exp(-r_i \cdot \Delta)$ today and x tomorrow, where $r_i > 0$ is player i's discount rate. In a second version the parties are not impatient but they face a risk that if agreement is delayed then the opportunity they hope to exploit jointly may be lost : player i believes that at the end of each bargaining period there is a positive probability $1 - \exp(-r_i\Delta)$ that the process will break down, $r_i > 0$. So, r_i can be interpreted either as player i's discount rate or as his estimate about the probability of a breakdown of the negotiations.

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

$$W_s^{\mathrm{SPE}} = \arg\max \left[U - U^0 \right]^{\alpha} \cdot \left[\Pi - \Pi^0 \right]^{1-\alpha} \tag{4}$$

where the lowerscript "s" means that wage bargaining is between the firm and surplus-maximizing union delegates, and where $U^0 = 0$ and $\Pi^0 = 0$ are, respectively, the disagreement payoffs of the union delegate and the firm. The parameter $\alpha \in (0;1)$ is the union bargaining power which is equal to $\frac{r_f}{r_u + r_f}$. Simple computation gives us

$$W_s^{\mathrm{SPE}} = \overline{W} + \alpha \frac{c}{1+c}(a - \overline{W}) = \overline{W} + \frac{r_f}{(r_u + r_f)} \frac{c}{(1+c)}(a - \overline{W}). \tag{5}$$

Obviously, the wage is increasing with the reservation wage $\overline{W}$, with the union bargaining power α, and with the parameter c. Then, one can easily obtain the equilibrium employment level

$$L_s^* = \left[\left(\frac{1 + c - \alpha c}{(1+c)^2 b} \right) \left(a - \overline{W} \right) \right]^{\frac{1}{c}}, \tag{6}$$

as well as the union's payoff and the firm's profit, which are denoted $U_s^*(\alpha)$ and $\Pi_s^*(\alpha)$, and are given by

$$U_s^*(\alpha) = \left[\frac{\alpha c}{1+c} \right] \left[\frac{1 + (1-\alpha)c}{(1+c)^2 b} \right]^{\frac{1}{c}} \left[a - \overline{W} \right]^{\frac{1+c}{c}}, \tag{7}$$

$$\Pi_s^*(\alpha) = \left[\left(\frac{1 + (1-\alpha)c}{(1+c)^2} \right) \left(a - \overline{W} \right) \right]^{\frac{1+c}{c}} \frac{c}{b^{\frac{1}{c}}}. \tag{8}$$

Second, we consider the case in which the union sends wage-maximizing delegates. Then, the predicted wage is given by

$$W_w^{\mathrm{SPE}} = \arg\max \left[V - V^0 \right]^{\alpha} \cdot \left[\Pi - \Pi^0 \right]^{1-\alpha} \tag{9}$$

where the lowerscript "w" means that wage bargaining is between the firm and wage-maximizing union delegates, and where $V^0 = 0$ and $\Pi^0 = 0$ are, respectively, the disagreement payoffs of the union delegate and the firm. The parameter $\alpha \in (0;1)$ is still the union bargaining power which is equal to $\frac{r_f}{r_u + r_f}$.[4] Simple computation gives us

$$W_w^{\mathrm{SPE}} = \overline{W} + \alpha \frac{c}{1 - \alpha + c}(a - \overline{W}) = \overline{W} + \frac{c\, r_f}{(1+c)\, r_u + c\, r_f}(a - \overline{W}). \tag{10}$$

[4] It is assumed that all union members have the same discount rate. The workers only differ with respect to their seniority within the firm (senior workers who are almost insulated from the threat of job loss) or if they are union delegates who are protected by law from being dismissed. So, the choice of the union is either to send a negotiator who will represent the entire workforce or to send a senior worker (or a union delegate). Involuntary lay-offs are typically done by inverse seniority within the plant or firm, the so called *last in, first out* (see Carruth and Oswald, 1989).

Again, the wage is increasing with the reservation wage $\overline{W}$, with the union bargaining power α, and with the parameter c. Then, one can easily obtain the equilibrium employment level

$$L_w^* = \left[\frac{1-\alpha}{(1-\alpha+c)\, b} \left(a - \overline{W} \right) \right]^{\frac{1}{c}}, \tag{11}$$

as well as the union's payoff and the firm's profit, which are denoted $U_w^*(\alpha)$ and $\pi_w^*(\alpha)$, and are given by

$$U_w^*(\alpha) = \left[\frac{\alpha c}{1-\alpha+c} \right] \left[\frac{(1-\alpha)}{(1-\alpha+c)\, b} \right]^{\frac{1}{c}} \left[a - \overline{W} \right]^{\frac{1+c}{c}}, \tag{12}$$

$$\pi_w^*(\alpha) = \left[\frac{(1-\alpha)}{(1-\alpha+c)} \left(a - \overline{W} \right) \right]^{\frac{1+c}{c}} \frac{c}{b^{\frac{1}{c}}}. \tag{13}$$

From (5), (8), (10) and (13) we obviously get that $W_w^{SPE} > W_s^{SPE}$ and $\pi_s^*(\alpha) > \pi_w^*(\alpha)$.

A natural question to ask at this point is whether union delegation reduces consumer surplus or social welfare. We denote by CS the consumer surplus. It is equal to

$$CS_s = \frac{c}{(1+c)\,(b)^{\frac{1}{c}}} \left[\frac{1+c-\alpha c}{(1+c)^2} (a - \overline{W}) \right]^{\frac{1+c}{c}} \tag{14}$$

for the case in which the union sends surplus-maximizing delegates, and it is equal to

$$CS_w = \frac{c}{(1+c)\,(b)^{\frac{1}{c}}} \left[\frac{1-\alpha}{1-\alpha+c} (a - \overline{W}) \right]^{\frac{1+c}{c}} \tag{15}$$

for the case in which the union sends wage-maximizing delegates. Comparing both expressions yields that the consumer surplus is always lower when the union sends wage-maximizing delegates rather than surplus-maximizing delegates.

In the first stage of the game, the union chooses whether to use surplus-maximizing delegates or wage-maximizing delegates to negotiate the wage with the employer. Comparing (7) with (12) we obtain the following proposition.

Proposition 1 *The union will send wage-maximizing delegates if and only if*

$$(1+c)^{c+2}(1-\alpha) \geq (1-\alpha+c)^{c+1}(1+c-\alpha c).$$

Proposition 1 tells us that: (i) for any given union bargaining power $\alpha \in (0,1)$, the more inelastic the product demand is (i.e. c is big), the more likely the union will choose to send wage-maximizing delegates; (ii) for any given degree of elasticity of the demand, the weaker the union is (i.e. α is small), the more likely the union will choose to send wage-maximizing delegates. Indeed, as c increases the more inelastic the product and labor demands become, and so even strong unions are more likely to send wage-maximizing delegates. In case the product demand is linear, $c = 1$, the union will choose to send wage-maximizing delegates if and only if $8(1-\alpha) \geq (2-\alpha)^3$. That is, the union will choose to send wage-maximizing delegates if and only if the union bargaining power is less or equal than $\alpha^* \simeq .76$. So, if the union is relatively not too strong, then the union will delegate the negotiation task to wage-maximizing delegates. This result advocates that care will be needed in the interpretation of econometric estimates of trade unions objectives done in the past since these estimates did not distinguish between the objective of the trade union and the objective of the union delegate who actually negotiated.[5] For example, Dertouzos and Pencavel's (1981) original analysis of the International Typographical Union (ITU) for the years 1946 to 1965 was to discriminate between popular alternative hypotheses about union objectives. The results they obtained support considerable diversity in union objectives among ITU locals. In regards with our analysis, their conclusion should be taken cautiously. Indeed, it could have been that ITU locals had the same objective but decided to send delegates who had different objectives.

However, both the asymmetric Nash bargaining solution and the Rubinstein's model predict efficient outcomes of the bargaining process (in particular agreement is reached immediately). This is not the case once we introduce incomplete information into the wage bargaining, in which the first rounds of negotiation are used for information transmission between the two negotiators.

4 The Wage Bargaining with Private Information

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

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

[5] See Pencavel (1991) for a survey of the empirical results on trade union objectives.

This lemma follows from Watson's (1998) analysis of Rubinstein's alternating-offer bargaining model with two-sided incomplete information.[6] Lemma 1 is not a direct corollary to Watson (1998) Theorem 1 because Watson's work focuses on linear preferences, but the analysis can be modified to handle the present case. Translating Watson (1998) Theorem 2 to our framework completes the characterization of the PBE payoffs.

Lemma 2 Consider the wage bargaining with incomplete information in which the period length shrinks to zero. For any $\hat{U} \in [U^*_{\cdot}(\underline{\alpha}); U^*_{\cdot}(\overline{\alpha})]$, $\hat{\Pi} \in [\Pi^*_{\cdot}(\overline{\alpha}); \Pi^*_{\cdot}(\underline{\alpha})]$, there exists distributions p_u and p_f, and a PBE such that the PBE payoffs are $\hat{U}$ and $\hat{\Pi}$.

In other words, whether or not all payoffs within the intervals given in Lemma 1 are possible depends on the distributions over types. As Watson (1998) stated, Lemma 1 and Lemma 2 establish that "each player will be no worse than he would be in equilibrium if it were common knowledge that he were his least patient type and the opponent were his most patient type. Furthermore, each player will be no better than he would be in equilibrium with the roles reversed". From Lemma 1 we have that the PBE wage outcome in case of the union chooses to send surplus-maximizing delegates, $W_s^*(\underline{\alpha};\overline{\alpha})$, satisfies the following inequalities:

$$\overline{W} + \frac{r_f^P}{(r_u^I + r_f^P)}\frac{c}{(1+c)}(a - \overline{W}) \le W_s^*(\underline{\alpha};\overline{\alpha}) \le \overline{W} + \frac{r_f^I}{(r_u^P + r_f^I)}\frac{c}{(1+c)}(a - \overline{W}). \qquad (16)$$

Notice that each wage satisfying these bounds can be the outcome by choosing appropriately the distribution over types. The lower (upper) bound is the wage outcome of the complete information game, when it is common knowledge that the union's type is r_u^I (r_u^P) and the firm's type is r_f^P (r_f^I) (and the union bargaining power is $\underline{\alpha}$ ($\overline{\alpha}$)). Expression (16) implies bounds on the firm's employment level, as well as on the firm's output, at equilibrium. In case of the union chooses to send wage-maximizing delegates, the PBE wage outcome, $W_w^*(\underline{\alpha};\overline{\alpha})$, satisfies the following inequalities:

$$\overline{W} + \frac{c\, r_f^P}{(1+c)\, r_u^I + c\, r_f^P}(a - \overline{W}) \le W_w^*(\underline{\alpha};\overline{\alpha}) \le \overline{W} + \frac{c\, r_f^I}{(1+c)\, r_u^P + c\, r_f^I}(a - \overline{W}). \qquad (17)$$

With complete information, the choice of wage-maximizing delegates always increase the wage level and decreases the production output (and the employment level) as well

[6] Watson (1998) characterized the set of PBE payoffs which may arise in Rubinstein's alternating-offer bargaining game and constructed bounds (which are met) on the agreements that may be made. The bounds and the PBE payoffs set are determined by the range of incomplete information and are easy to compute because they correspond to the SPE payoffs of two bargaining games of complete information. These two games are defined by matching one player's most impatient type with the opponent's most patient type.

as the consumer surplus. But when the players possess private information, the complete information results are not always valid. The necessary and sufficient condition to recover the complete information result that the wage outcome in case of surplus-maximizing delegates is always strictly smaller than the wage outcome in case of wage-maximizing delegates is

$$c < \frac{r_f^P r_f^I - r_u^I r_f^I + r_u^P r_f^P}{r_u^I r_f^I - r_u^P r_f^P}. \tag{18}$$

This condition is satisfied the smaller the amount of private information $|\overline{\alpha} - \underline{\alpha}|$ and the parameter c are. So, the more elastic the product demand is the more likely the wage outcome in case of wage-maximizing delegates will be higher than the wage outcome in case of surplus-maximizing delegates even in presence of incomplete information. The condition (18) can be rewritten as $\underline{\alpha}(1+c) > \overline{\alpha}(1-\underline{\alpha}+c)$. Hence, if it is commonly known that union is stronger than the firm ($\underline{\alpha} \geq .5$) and the labor demand is quite elastic ($c \leq 1$), then we get $W_w^*(\underline{\alpha};\overline{\alpha}) > W_s^*(\underline{\alpha};\overline{\alpha})$, $CS_w(\underline{\alpha};\overline{\alpha}) < CS_s(\underline{\alpha};\overline{\alpha})$ and $L_w^*(\underline{\alpha};\overline{\alpha}) < L_s^*(\underline{\alpha};\overline{\alpha})$. The intuition behind this result is the following one. Firstly, incomplete information in the model takes into account two main features. The first one is the amount of private information in possession of the players. By the amount of private information we mean the size of the set in which player's discount rate is contained and which is common knowledge between the players. The second one is the uncertainty about who is the more patient player, i.e. who is the stronger player. When it is common knowledge that the union is stronger, this second feature disappears, and information tends to play a less crucial role in the process of the negotiation between the firm and the union delegates. Secondly, if the elasticity of product and labor demands is high, a wage increase will imply a significant drop in employment level and, hence, it will refrain surplus-maximizing delegates from demanding high wages. Therefore, we recover the above complete information results once it is common knowledge that the union is stronger than the firm and the elasticity of product and labor demands is high enough. The next proposition summarizes this result.

Proposition 2 *If it is commonly known that the union is stronger than the firm ($\underline{\alpha} \geq \frac{1}{2}$) and the labor demand is quite elastic ($c \leq 1$), then $W_w^*(\underline{\alpha};\overline{\alpha}) > W_s^*(\underline{\alpha};\overline{\alpha})$.*

Obviously, from Lemma 1 and Lemma 2 inefficient outcomes are possible, even as the period length shrinks to zero. Inefficiency can occur in two ways. First, players might agree to throw away some of the resource over which they are bargaining, even when agreement is reached without delay. Second, the negotiation may involve considerable delay, even if the eventual agreement is efficient on its own. While the scope of possible inefficiency is clear from Lemma 1 and Lemma 2, what is not so obvious is the potential for delay. In fact, the wage bargaining game may involve delay (strikes or lock-outs), but not perpetual disagreement, at equilibrium. Indeed, Watson (1998) has constructed a bound on delay in equilibrium which shows that an agreement is reached in finite time and that delay time equals zero as incomplete information vanishes.

5 The Strike Activity

In the literature on strikes [see e.g. Cheung and Davidson (1991), Kennan and Wilson (1989, 1993)], three different measures of strike activity are usually proposed: the strike incidence, the strike duration, and the number of work days lost due to work stoppages. Since we allow for general distributions over types and we may encounter a multiplicity of PBE, we are unable to compute measures of strike activity as the ones just mentioned. In order to compute an expected strike duration one would need to fix some parameters of the model such as the distribution over types but it would imply a substantial loss of generality. Nevertheless, we propose to identify the strike activity (strikes or lock-outs) with the potential inefficiency in reaching a wage agreement. Following Watson (1998) Theorem 3, the larger is the difference between the upper bound and lower bound on the bargaining outcome, the larger is the potential inefficiency for obtaining an agreement and the larger is the possibility of delay in reaching an agreement. Therefore, the strike activity is given by the difference between the upper bound and the lower bound on the wage outcome and it can be interpreted as an indicator of both the level of potential inefficiency and the strike duration.[7]

When the union chooses surplus-maximizing delegates to bargain the wage with the firm, the strike activity is given by the following expression.

$$\Psi_s = (\overline{\alpha} - \underline{\alpha})\left(\frac{c}{1+c}\right)\left(a - \overline{W}\right) \tag{19}$$

$$= \left[\frac{r_f^I r_u^I - r_f^P r_u^P}{\left(r_f^P + r_u^I\right)\left(r_f^I + r_u^P\right)}\right]\left(\frac{c}{1+c}\right)\left(a - \overline{W}\right). \tag{20}$$

Therefore, Ψ_s is an increasing (decreasing) function of r_u^I (r_u^P), is a decreasing (increasing) function of r_f^P (r_f^I), and is decreasing with the reservation wage $\overline{W}$. We observe also that the strike activity is decreasing with the degree of elasticity of the product demand: $\frac{\partial \Psi_s}{\partial c} > 0$. That is, the more inelastic the demand is the more strikes will occur.

When the union chooses wage-maximizing delegates to bargain the wage with the firm,

[7] Our measure of strike activity gives the scope each player has for screening his opponent by making wage proposals satisfying the expressions (16) or (17), and hence, for delaying the wage agreement. Only *in average* this measure is a good proxy of actual strike duration.

the strike activity is given by the following expression.

$$\Psi_w = c\left(\frac{\bar{\alpha}}{1-\bar{\alpha}+c} - \frac{\underline{\alpha}}{1-\underline{\alpha}+c}\right)(a - \overline{W}) \tag{21}$$

$$= \frac{c(1+c)\left[r_f^I r_u^I - r_f^P r_u^P\right]}{\left[c\, r_f^P + (1+c) r_u^I\right]\left[c\, r_f^I + (1+c) r_u^P\right]}\left(a - \overline{W}\right). \tag{22}$$

Again, Ψ_w is an increasing (decreasing) function of r_u^I (r_u^P), is a decreasing (increasing) function of r_f^P (r_f^I), and is decreasing with the reservation wage $\overline{W}$. But now the strike activity might be decreasing or increasing with the degree of elasticity of the product demand. Precisely, the strike activity is decreasing with the degree of elasticity of the product demand, $\frac{\partial \Psi_w}{\partial c} > 0$, if and only if $(1+c)^2 r_u^P r_u^I > c^2 r_f^P r_f^I$. So, we can state the following results: (i) if it is common knowledge that the union is weaker than the firm then $\frac{\partial \Psi_w}{\partial c} > 0$; (ii) if it is common knowledge that the firm is $\left(\frac{1+c}{c}\right)^2$ times weaker than the union then $\frac{\partial \Psi_w}{\partial c} < 0$.

From both expressions of strike activity we observe that, for any given amount of private information $|\bar{\alpha} - \underline{\alpha}|$ the stronger the union might be (i.e. the bigger $\underline{\alpha}$ is) the greater the strike activity will be. This result is confirmed by Tracy (1986) empirical study of the determinants of U.S. labor disputes. He found that the higher the union coverage rate (which is a proxy for the union bargaining power) is, the more likely strikes will occur and last. Moreover, comparing the expressions (19) and (21) we can state the following proposition.

Proposition 3 *The strike activity is greater whenever the union chooses wage-maximizing delegates instead of surplus-maximizing delegates. That is, $\Psi_w > \Psi_s$.*

Whether strategic union delegation will increase or decrease the strike activity is not obvious at first sight. The wage objective of surplus-maximizing delegates (who do care about output levels) is not clear-cut as it is for the wage objective of wage-maximizing delegates (who do not care about firm's output). Hence, surplus-maximizing delegates have more scope to hide their type, which is private information, in order to try to reach a more favorable outcome. As a consequence, the firm who still claims lower wages may need more time, during the negotiation, to screen the union's type when bargaining occurs with surplus-maximizing delegates rather than with wage-maximizing delegates. But this effect is in fact dominated by the conflict of interest which is so strong between the firm and the wage-maximizing delegates and which induces the wage-maximizing delegates to concede more slowly than surplus-maximizing delegates do.

From Proposition 3 we know that if the union chooses to send wage-maximizing delegates then the strike activity is going to increase. Now we turn to investigate whether and when it is optimal to delegate for the union. The necessary and sufficient condition such that it is always optimal for the union to choose wage-maximizing delegates is

$$\left[\frac{\underline{\alpha} c}{1-\underline{\alpha}+c}\right]^{c}\left[\frac{(1-\underline{\alpha})}{(1-\underline{\alpha}+c)b}\right] \geq \left[\frac{\bar{\alpha} c}{1+c}\right]^{c}\left[\frac{1+(1-\bar{\alpha})c}{(1+c)^2 b}\right] \tag{23}$$

Take the case of a linear demand (c is equal to 1). Then, the above condition becomes:

$$\frac{\underline{\alpha}(1-\underline{\alpha})}{(2-\underline{\alpha})^2} \geq \frac{\bar{\alpha}(2-\bar{\alpha})}{8} \tag{24}$$

From (24) we can make the following two remarks. First, if it is commonly known that the union is weaker than the firm (i.e. $\bar{\alpha} \leq \frac{1}{2}$) and the union is not too weak (i.e. $\underline{\alpha} \geq \frac{2}{5}$) then it is optimal for the union to send wage-maximizing delegates. Second, if it is commonly known that the union is stronger than the firm (i.e. $\underline{\alpha} \geq \frac{1}{2}$) and the union is not too strong (i.e. $\bar{\alpha} \leq \frac{13}{20}$) then it is optimal for the union to send wage-maximizing delegates. Finally, notice that the increase in strike activity due to strategic delegation may be far from being negligible. For example, if $\bar{\alpha} = \frac{1}{2}$ and $\underline{\alpha} = \frac{2}{5}$ then allowing strategic union delegation will increase at equilibrium the strike activity by 66%. Even more, if $\underline{\alpha} = \frac{1}{2}$ and $\bar{\alpha} = \frac{13}{20}$ then strategic union delegation will increase the strike activity by 100%. As a measure of the efficiency loss due to strategic delegation we propose the ratio between the strike activity in case the union chooses wage-maximizing delegates and the strike activity in case the union chooses surplus-maximizing delegates,

$$\frac{a_w}{a_s} = \frac{(1+c)^2}{(1-\bar{\alpha}+c)(1-\underline{\alpha}+c)} \tag{25}$$

This ratio is bounded above by $(\frac{1+c}{c})^2$ and below by 1 (cfr. Proposition 3). So, by giving the option to the union to delegate, the strike activity and the inefficiency loss can increase considerably. Indeed, the strike activity with wage-maximizing delegates can be up to $\frac{(1+c)^2}{c(\varepsilon+c)}$ times the strike activity with surplus-maximizing delegates with ε small. For example, if the demand is linear ($c = 1$) then this ratio will be close to 4 which is not negligible.

6 Conclusion

We have developed a model of wage determination with private information, in which the union has the option to delegate the wage bargaining to either surplus-maximizing delegates or to wage-maximizing delegates (such as senior union members). We have shown that the strike activity is greater whenever the union chooses wage-maximizing delegates instead of surplus-maximizing delegates. We have also determined when it is always optimal for the union to choose wage-maximizing delegates and we have found that the efficiency loss due to strategic delegation can be important. From a policy perspective our analysis questions whether one should allow for strategic delegation (for example, by means of laws protecting union delegates from being dismissed). From a research perspective our analysis questions theoretical results obtained under complete information as well as empirical studies of the trade union objectives. A direction for future research is to test empirically the relevance of strategic union delegation and to overcome the identification problem with respect to the trade union objective and the negotiator objective.

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