Union Leaders as Experts: Wage Bargaining and Strikes with Union-Wide Ballot Requirements*

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Abstract

To avoid strikes and curb labour militancy, some governments have introduced legislation stating that union leadership as well as wage offers should be decided through union-wide ballots. This paper shows that members still have incentives to appoint militant union leaders, if these leaders have access to information critical for the members' voting decisions. Furthermore, conflicts may arise in equilibrium even though the contract zone is never empty and there is an option to resolve any incomplete information. Ballot requirements hence preclude neither militant union bosses nor inefficient conflicts. [*Keywords: Applied game theory, communication, labour markets. JEL codes: J51, J52, C78*]

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I Introduction

Recent history features many examples of political attempts to temper labour militancy. A well known example is that of the United Kingdom, where Conservative governments enacted legislative reforms between 1980-1993 that fundamentally affected relationships between and within labour market organizations. A crucial part of the legislative agenda was requirements for secret ballots prior to industrial action as well as for union leadership elections (included in the Trade Union Act of 1984).[1] The stated objective of these requirements was to increase union democracy, basically by undermining the authority of union bosses (Morris and Fosh, 2000). The Conservative government, with support from contemporary polls, perceived the majority of the rank-and-file to be more moderate than their leaders. The militancy of the union leadership led in their view to excessive wage claims and a staggering frequency of labour market conflicts. By enforcing secret ballots the government hoped that more moderate leaders should be elected and that the number of strikes should be substantially reduced if not even eliminated. However, this hope was only partially realized. The number of conflicts did go down but strikes were far from eliminated; Addison and Siebert (2003) still estimate the number of stoppages in Britain to around 200 a year in most of the 1990's.[2] In this paper a model that offers a potential explanation for this observation is developed. More specifically, the model suggests a mechanism through which the rank-and-file can increase their bargaining power by electing more militant union bosses, even though the leadership has no real authority. The model also shows that this may lead to strikes in equilibrium, even in a situation

[1] Balloting is by no means unique to the case of UK. For instance, secret elections for local union offices were established already in the Landrum-Griffin act of 1959 in the USA. On the other hand, unions are not required by law in the US to hold ballots for new contracts, but most unions specify a requirement for ratification within their constitutions or by-laws. Also, the Taft-Hartley act of 1949 specifies that strike ballots on the firm's final offer should be undertaken during a cooling of period in cases when strikes can lead to national emergencies. Examples of other countries were strike ballots are required for legal strikes are Canada and Norway.

[2] The fact that ballots are no panacea is also evident from the US experience, based on the provision of strike ballots in the Taft Hartley Act. The so called "failure of ratification" literature clearly documented how expectations of a smoother bargaining outcome often failed to be realized (e.g. Simkin 1967, Burke and Rubin 1973, Cappelli and Sterling 1988).

where the contract zone is never empty and incomplete information can be resolved.

The provision that wage offers and decisions to strike must get support in secret ballots implies that real authority rests with the union membership rather than the leadership. This begs the question: If real authority rests with the rank-and file, what is then the role of the union leadership? What is suggested in this paper is that a crucial role of union leaders is that of agitators, or to use the terminology of communication games, experts (Crawford and Sobel 1982). Even though not recognized in formal models, the broader literature on wage bargaining has since long argued that an important source for leadership influence goes through access to and dissemination of information (e.g. Freeman and Medoff, 1984). It has generally been the norm to consult with union members before crucial decisions even when laws, union constitutions and by-laws give the leadership real authority (Undy and Martin, 1984). Consent from members is crucial for the legitimacy and long-term survival of the leadership, and much effort has been devoted to convincing members of the righteousness of the leadership's stance. Influence is made possible by the fact that the union leadership often has access to information that is out of reach for the rank-and-file through the formers regular interaction with the management of the firm.[3] In some cases, Sweden and Germany being two examples, this is formalized through union representation on company boards, while in other cases it takes the form of voluntary or mandatory consultation. For instance, recent legislation within the European Community requires that "..employers inform employees about the undertaking's economic situation, and consult them on employment prospects (including threats to employment and anticipatory measures to deal with them) as well as on decisions likely to lead to substantial changes in work organization or contractual relations." (Addison and Siebert, 2003, p. 450). This consultation, by law, has to be with employee representatives. This suggests that

[3]The following quote, from Undy and Martin, 1984, p. 166, nicely summarizes both the ability and desire of union leaders to influence their members voting decisions: "..since negotiators determined the question, and had a major influence upon the relevant information available, they were normally able to ensure that balloting confirmed the negotiators' preferences, whether for acceptance or rejection."

information many times will be filtered through the union leadership, even though the employee representatives wont necesarilly always be from a trade union.

The model I develop is the simplest possible bargaining game with the addition of communication between an endogenously determined union leader and the rank-and-file. Before bargaining begins, the union votes on the identity of the union leader. Following that, the firm offers union members a wage contract. If the offer is turned down a (costly) conflict breaks out until a final binding wage is set through arbitration. The wage offer is accepted or rejected through a union wide ballot, so real authority rests with the rank-and-file, not the union leader. However, the union leader is better informed about the likely outcome of arbitration so he will be able to influence the election by strategic information dissemination. In the equilibrium characterized (as in most signalling games there are multiple equilibria), the union leader's signal can be interpreted as a binary recommendation whether to accept or reject the current offer. Whether the union will follow this recommendation or not will depend on the size of the wage offer and the information value of the union leader's signal.

If the union leader has identical preferences to that of the pivotal voter within the union, then the recommendation will always be followed and there is no risk of a conflict. However, as in the case of delegation of real authority, union members can increase their bargaining power by appointing a more militant union leader since the firm then will have to offer a higher wage in order to get endorsement from the union leadership. Contrary to the case of delegation of real authority, though, bargaining power does not increase monotonically with the militancy of the union leader. The reason is that endorsement is not necessary for the union members to accept the wage offer, endorsement only serves as a signal about the likely outcome in case of arbitration. And the more militant is the union leader, the less informative is the signal, since an extreme union leader would

reject a wide range of wage offers that a majority of the rank-and-file would be willing to accept. It follows that the more militant is the union leader, the lower is the wage necessary to get a union majority to go against their leader's recommendation to call a strike. The relationship between bargaining power and the militancy of the union leader is thus non-monotonic, suggesting that the optimal union leader will be more strike prone than the majority of union members but not an extremist. Nevertheless, if the firm's cost of a conflict is private information then the model predicts that there may be inefficient conflicts in equilibrium. That private information leads to potentially inefficient outcomes is not surprising (Myerson and Satterthwaite, 1983), but in this case it happens even though the contract zone between the firm and a majority of union members is never empty and even though the pivotal union member has the option to resolve the incomplete information.[4] Hence, union members trade bargaining power against the risk of conflict in their choice of union leader.

The idea that a player engaged in an ultimatum game may benefit from incomplete information is not new to the bargaining literature. What is new, though, is that union members can commit to certain information sets by their choice of union leader. The main contribution of the paper is thus to show how the choice of union leader (or expert more generally) serves as a credible signal of toughness even when the union leader has no real authority. A strategic choice of union leader credibly commits the union members to turn down offers they would have accepted were they better informed, which forces the firm to share part of the surplus with its employees.[5]

The paper is organized as follows. Section 2 offers a short literature review. The model is outlined in Section 3, together with a discussion of equilibrium selection. Section 4 presents a

[4] The Myerson-Satterthwaite Theorem relies on the assumption that the seller's and buyer's valuations overlap, i.e. that there are realizations such that no trade is the efficient outcome. In the wage bargaining setting this is equivalent to saying that there are realizations such that the contract zone is empty. In my model this is never the case, so conflict is never the efficient outcome, but it may still happen with positive probability.

[5] A similar result is also analyzed in Olofsgård (2004) in the context of secessions and referenda.

benchmark with no union leader, while Section 5 solves the game with communication between a union leader and the rank and file. In Section 6 a further layer of uncertainty is introduced, opening up for the possibility of strikes in equilibrium. Critical assumptions are discussed in Section 7, and Section 8 concludes.

II Literature Review

The economic literatures on bargaining and trade unions are vast and span areas from pure game theory to applied industrial relations. The ambition of this section is therefore very limited in scope, focusing on the theoretical contributions that have the most relevance for what is done in this paper. In particular, I will focus on papers that explicitly deal with labour markets and that address issues of private information, signalling and commitment.

The influential paper by Ashenfelter and Johnson (1969) also assumes that union leaders are better informed than the rank-and-file. Leaders know the set of feasible wage claims, but they are (for some unspecified reason) unable to communicate this information to the rank-and-file. To maintain their leadership, they will sometimes prefer to call a strike in order to lower expectations, rather than accepting a wage offer that is deemed by the rank-and-file as too low. Strikes are thus the result of divergent expectations that are assumed to gradually converge as the strike goes on. The actual model, though, is a reduced form of their underlying idea with no micro foundations for union members' behaviour, and no explicit role for the union leader, so issues of signaling cannot be addressed. Also, real authority is (implicitly) assumed to belong to the union leader, not the rank-and-file.

Hayes (1984), Kennan and Wilson (1993) and Cramton and Tracy (2003) are examples of game-theoretic models with micro foundations building on the idea that strikes serve the purpose of

soliciting information. As in Ashenfelter and Johnson (1969), the union's expectation of how much the firm is willing to pay gradually decreases as the conflict goes on, but now this relies on the explicit idea that the firm's rejection sends a (costly) signal about profitability. Hence, the union is continuously updating its beliefs based on the fact that the firm has not yet given in. The union is here modeled as a unitary actor, though, so there is no discussion about internal politics within the union (see Oswald, 1985, for a critical discussion of the unitary actor assumption). Also, the focus is only on signaling between the firm and the union, not from union leaders to union members, and signals are modeled as costly since communication between two agents with fundamentally opposing interests lacks credibility.

Jones (1989) and Goerke and Hefeker (2000) apply the well known idea that bargaining power can be enhanced by delegating real authority to less risk-averse negotiators. A more militant union leader thus serves as a form of commitment to "playing tough", rationalizing the widely held idea that the union leadership and rank-and-file members have different preferences.[6] The model presented here can be thought of as an extension of this idea, showing that delegation of real authority is not necessarily crucial for the union members' ability to commit to a tough position. As long as union leaders have access to superior information, electing more militant members to serve in office may do the trick. On the other end of the spectrum are public choice models of union behaviour with heterogenous preferences and union leaders who implement the optimal policy of the median voter (e.g. Booth, 1984, and Blair and Crawford, 1984). These models do not address issues of independent roles of union leaders and their members, but rather focus on issues of how to aggregate individual preferences into a union objective function, and how to apply those aggregated preferences into a bargaining framework in a consistent way.

[6] Crawford (1982), in a more general bargaining framework, presents a model where partial commitment can be achieved through demands that can be withdrawn only at a cost. When the cost is uncertain, then there may be impasses in equilibrium even when agreement is the efficient outcome.

III The Model

Union membership is given by a continuum, the size of which is normalized to one. Union members are all identical except for their cost of conflict, c. The distribution of c is given by the continuous density function $k(c)$ with full support on $[\underline{c}, \bar{c}]$, where $\underline{c} < 0 < \bar{c}$.[7] The median voter theorem applies, so a simplified game with only two players from the union is considered. The first player is the decisive voter within the rank and file, the member with the median cost of conflict, denoted as m (her). The second is the union leader, denoted as u (him), who is appointed from within the union membership by the decisive union member. The third and final player of the game is the firm, f (it), who also carries a cost of conflict given by c_f. This cost is drawn from a continuous distribution $g(\cdot)$ with full support on the unit interval.

There are two parts to the model. First the union member selects the type of the union leader. After that, the wage is determined. The wage setting game is modeled as a two-stage ultimatum game where the firm in the first stage decides on a wage offer, w_o. If the union member, after having consulted the union leader, turns the wage down, then there is a conflict.[8] The wage is then set after some delay by an impartial arbitrator in stage 2.[9] It is assumed, following the literature (e.g. Ashenfelter 1987, Ashenfelter and Currie 1990), that the outcome of arbitration, denoted as w_a, can be represented by a random draw from a continuous distribution. This distribution is given by the density function $h(\cdot)$ with full support on the unit interval and with expected value $\bar{w}_a$. The realization of the draw is observed by the firm and the union leader but not by the union member.

[7] The assumption that $\underline{c} < 0$ implies that there exists union members for who the contract zone between them and the firm is potentially empty. One way of rationalizing this assumption is that some union members perceive a benefit of a conflict, due for instance to the opportunity to make extra money on the side or due to non-monetary perks such as leisure, camaraderie or the rise in self-esteem that a conflict can generate. An alternative would be to assume that all members bear a negative financial cost of a conflict, but that union leaders also receive a personal gain due to the impact on their reputation of toughness for instance (e.g. Ashenfelter and Johnson 1969).

[8] Actual legislation varies across countries, in some cases wage offers can be accepted by union leaders and only decisions to strike or terminate a strike are taken by ballots.

[9] The notion that arbitration means a binding recommendation is common but not universal (see for instance Manzini and Mariotti, 2001). Furthermore, there are different forms of arbitration. I model what is sometimes referred to as conventional arbitration (Farber and Bazerman, 1986).

To be more precise, the timing and strategies of the game are as follows. First of all nature draws the realizations of w_a and c_f. Then player m selects the type u from the union membership. Her strategy is defined as $c_u\left(c_m, h\left(\cdot\right), g\left(\cdot\right)\right) \in [\underline{c}, \overline{c}]$. Then the firm offers a wage, $w_o\left(c_m, c_u, c_f, w_a\right) \in R$. Based on that wage offer, the union leader sends a message, θ, with information about the realization of w_a. The message can be any interval on the support of $h\left(\cdot\right)$, i.e. $\theta\left(c_u, w_o, w_a\right) \in int\left[0,1\right]$. The union member updates her beliefs of w_a, denoted as $\tilde{h}\left(w_a \mid \cdot\right)$, based on w_o and θ, and decides whether to accept or reject the offered wage. Her strategy is given by $\sigma_m\left(c_m, w_o, \tilde{h}\left(w_a \mid \cdot\right)\right) \in \{a_m, r_m\}$, where a stands for accept, and r stands for reject. Finally, payoffs are realized.

To keep things tractable it is assumed that preferences are linear in income. The utility of player $i \in \{m, u\}$ is given by

$$u_i\left(w, c_i\right) = w - dc_i, \tag{1}$$

where w is the wage, c_i is the cost of a conflict and d is an indicator function that takes on the value of 1 in case of a conflict, and 0 otherwise. It is also assumed throughout that $c_m > 0$. It follows that there would never be a conflict in equilibrium with complete information since $c_f \geq 0$. Furthermore, it is assumed that $\bar{w}_a - c_m > 0$, i.e. that the firm must offer a strictly positive wage in order to avoid a conflict if the union member relies only on her prior beliefs.

Finally, the firm's utility function is also linear in income and represented by

$$u_f\left(w, c_f\right) = \rho - w - dc_f, \tag{2}$$

where ρ represents revenues.

Equilibrium Selection

The bargaining sub-game is solved for a perfect Bayesian equilibrium with the following properties: i) for all θ and w_o, $\sigma_m(c_m, \theta, w_o)$ maximizes the union member's expected utility given the beliefs $\tilde{h}(w_a \mid \theta, w_o)$; ii) for all w_a and w_o, and given the strategy σ_m, $\theta(c_u, w_o, w_a)$ maximizes the union leader's utility; iii) for all w_a, and given the strategies σ_m and θ, $w_o(c_m, c_u, c_f, w_a)$ maximizes the firm's utility; iv) the updated beliefs $\tilde{h}(w_a \mid \theta, w_o)$ are formed based on θ and w_o by applying Bayes' rule whenever applicable.

As in most signaling games, this model features multiple equilibria. To characterize all of these goes beyond the ambition of this paper, instead, the focus of the analysis will be on a particular equilibrium. Given the applied character of the paper, the motivation for studying this particular equilibrium is based primarily on observations of actual behavior and the existing wage bargaining literature.

As explained in detail in the coming sections, the equilibrium of the wage bargaining sub-game I characterize looks as follows. The firm plays a partially pooling strategy in which for all outcomes of arbitration above a certain cut-off, it offers a wage high enough to just be accepted, and for all outcomes below the cut-off it offers a wage low enough to be rejected. The union leader sends an imprecise but truthful message revealing only whether the realization of wage arbitration lies in the subset of realizations for which the leader himself prefers to accept the current offer, or if it lies in the subset for which he prefers to reject the offer. That is, one can think of his signal as an endorsement or a rejection. The union member then updates her beliefs about the outcome of arbitration based on these signals, and decides whether to accept the offer or not.

The motivation for focusing on this particular equilibrium goes as follows. First of all, I restrict attention to pure strategies on behalf of the union. Unions typically enter wage bargaining

announcing a target wage increase. This target may not necessarily be reached, but there is clearly a lower bound deemed acceptable, and it is hard to phantom a real world union arguing that every wage offer will be accepted by some probability p within the open set (0,1). It should be stressed, though, that from a theoretical perspective, this is not an innocuous assumption. As showed in Reinganum and Wilde (1986), looking at litigation rather than wage bargaining, there exists a separating equilibrium in mixed strategies in which all information is revealed in the benchmark game analyzed in Section 5.

Secondly, as in some of the wage bargaining models discussed in Section 2, the firm sends a costly signal through its wage offer, but I do rule out communication from the firm to the union member. This is the standard assumption in the literature, and it is mainly motivated by the fact that communication between two parties with completely opposite interests typically fails to be credible, but it is also in line with legislation in some countries, the US and Italy for instance, that explicitly bans management to consult with workers over the head of union representatives (Wedderburn, 1997).[10]

Finally, as in all communication games, there exist multiple informative equilibria that are economically equivalent, but differ in terms of the precision of the information conveyed in the sender's message. Typically, in games where the receiver's strategy space is continuous, the analysis then focuses on the most informative equilibrium. In the case when the strategy space is binary,

[10]It should be noted that Krishna and Morgan (2001a, 2001b) have shown that it is possible to generate an equilibrium in which the receiver gets precise information in a more general cheap talk game with two exogenously given senders, even if one of them has extreme preferences. If such an equilibrium could be constructed here, then the union members would know the exact realization of w_{a} and there would be no risk of conflict. There are several important differences between the two models though. In particular, a critical difference is that the strategy space of the receiver in this model is just binary, accept or reject. This makes it impossible to play off the preferences of the two senders against each other in a similar way as done in Krishna and Morgan to generate truthfulness. Furthermore, it is crucial for the results in Krishna and Morgan that the two senders are of opposite bias. This is not the case in the wage bargaining game. Note also that in Krishna and Morgan's models, as in most cheap talk applications, the receiver is always better off with as precise information as possible and the identities of the senders are exogenously given. In my model the receiver prefers biased information. She can always get precise information by electing a leader with identical preferences to her own, but, for strategic reasons, she prefers not to. Hence, it is not even in the receiver's interest to play out the two senders against each other in order to get more precise information.

though, the least informative of these economically equivalent equilibria can be interpreted as an endorsement strategy on behalf of the union leadership. This seems consistent with actual union practices. As pointed out in Undy and Martin (1984, p. 166), when decisions are taken through union wide ballots, union leaders typically offer a suggestion whether the wage offer should be accepted or not prior to the vote.[11]

IV Wage Bargaining without a Union Leader

To clarify the role of an informed union leader a simple game with only an informed firm and an uninformed union member is solved as a point of reference. As discussed in the previous section, the attention is focused on an equilibrium in pure strategies in which the firm is following a partially pooling strategy. For all w_a above some cut-off point the firm offers a wage just high enough to be accepted. For all w_a below that cut-off, the firm offers a wage low enough to be declined. There is no communication between the firm and the union, but the wage offer itself serves as a costly signal. To be more precise, it is assumed that union members only expect the firm to offer wages that would make it better off if accepted than rejected. It follows that a higher wage offer signals that the outcome of arbitration may be quite favourable to the union.

Formally, envision the following set of strategies and beliefs. The firm offers w^H if $w_a \geq w^*$, and w^L, which is strictly less than w^H, if not. The union member accepts any wage offer $w_o \geq w^H$ and rejects any wage offer $w_o < w^H$. To complete the description of the equilibrium, a set of beliefs consistent with the strategies above, and Bayes' rule when applicable, are defined below. The first two rows on the right hand side follow from the firm's strategy and Bayes' rule. The third row

[11] Communication games also always have so called babbling equilibria in which the receiver expects that the message from the sender is pure noise and the sender, knowing this, sends pure noise since his signal is disregarded anyway. These equilibria are not very interesting in most applications, and are therefore, almost without exception, ignored in applied papers.

states that all offers except $\{w^L, w^H\}$ are believed to come from a firm which observes $w_a = 1$.

$$E[w_a \mid w_o] = \begin{cases} \int_{w^*}^{1} w_a \frac{h(w_a)}{(1-H(w^*))} dw_a & if\ w_o = w^H \\ \int_{0}^{w^*} w_a \frac{h(w_a)}{H(w^*)} dw_a & if\ w_o = w^L \\ 1 & otherwise \end{cases} \tag{3}$$

To pin down w^*, note that the union member updates her beliefs understanding that the firm would never offer a wage that leaves it worse off if accepted than if rejected, i.e. $w_a + c_f \geq w^H$. It follows that $w^* = w^H - c_f$, and

$$E[w_a \mid w^H] = \int_{\max\{w^H - c_f, 0\}}^{1} w_a \tilde{h}\left(w_a \mid w^H\right) dw_a, \tag{4}$$

where $\tilde{h}\left(w_a \mid w^H\right) = h\left(w_a\right) / (1 - H\left(\max\left\{w^H - c_f, 0\right\}\right))$. The firm maximizes utility by minimizing expenditures, including the cost of conflict. The wage offer w^H must therefore be the lowest wage that will be accepted. This wage is defined by the union member's indifference condition, i.e. the w^H that satisfies the following equality

$$w^H = \int_{\max\{w^H - c_f, 0\}}^{1} w_a \tilde{h}\left(w_a \mid w^H\right) dw_a - c_m. \tag{5}$$

Note that the left hand side is strictly smaller than the right hand side when $w^H = 0$, since $\bar{w}_a - c_m > 0$ by assumption. Note also that the left hand side is strictly greater than the right hand side when $w^H = 1$, since $w_a \leq 1$ and $c_m > 0$. This guarantees the existence of a fixed-point, together with the fact that both sides are monotonically increasing in w^H. It is assumed that the properties of the $h\left(\cdot\right)$ function are such that the fixed-point is unique. If c_m and c_f are high enough, i.e. if $w^H < c_f$, then the union member cannot rule out any realizations of w_a. The wage offer hence carries no more information in this case than what the union member already knows, and $w^H = \bar{w}_a - c_m$.

If $w_a < w^H - c_f$ then the firm is not willing to offer what is required to avoid a conflict.[12] Instead it offers a wage $w^L < w^H$, which fulfills the inequality $w^L < E[w_a \mid w^L] - c_m$, where[13]

$$E[w_a \mid w^L] = \int_0^{\max\left\{w^H - c_f, 0\right\}} w_a \tilde{h}\left(w_a \mid w^L\right) dw_a, \tag{6}$$

and $\tilde{h}\left(w_a \mid w^L\right) = h\left(w_a\right) / H\left(\max\left\{w^H - c_f, 0\right\}\right)$. This condition guarantees that the union member will not accept this wage.

Finally, note that any other wage offer than $\left\{w^H, w^L\right\}$ will only be accepted if it weakly exceeds $1 - c_m$, which is strictly higher than w^H. Hence, there is no reason for the firm to ever offer any other wage than $\{w^L, w^H\}$, so the beliefs specified in the third row in equation (3) are out of the equilibrium path. Note also that there are potential conflicts in equilibrium as long as $w^H > c_f$. These conflicts are always inefficient, in the sense that there always exists a w_o that the firm is willing to offer and the union would accept if information was complete, since both c_f and c_m are greater than zero by assumption.

V Wage Bargaining with an Informed Union Leader

In this section an informed union leader is added to the game of the previous section. This means that the union member now receives an additional signal, this time in the form of communication, on which to update her beliefs about the realization of w_a. Together with the fact that the union member can pick the identity of the leader, this suggests that there is now an opportunity for her to become sufficiently informed to eliminate the risk of inefficient conflicts. In particular, a leader with preferences identical to those of the union member would have no incentives to mislead the member to reject an offer the member would be better of accepting, or vice versa. It follows that

[12] Obviously, if c_f is high enough then this set is empty, since $w_a \in [0, 1]$.

[13] The wage offered can be any number low enough to cause rejection, given the specified beliefs. Hence, strictly speaking there exists an infinite number of different equilibria with different low-wage offers, but they are economically equivalent.

no conflict would arise in this case, since the contract zone between the firm and the decisive union member is never empty.

This may not necessarily be good from a strategic perspective, though. An upbeat assessment of the outcome in case of arbitration, even if incorrect, may be a way for the union members to boost their bargaining power, as long as the firm is aware of this assessment and believe that union members indeed will act in accordance. That is, just claiming to believe that the wage outcome of arbitration will be high will not do the trick, union members need an instrument to credibly commit to such a belief. This is where the potential strategic benefit of a more militant union leader lies. As pointed out above, and shown below, the signal from the union leader can be seen as an endorsement strategy. A more militant union leader will require a higher wage in order to endorse an acceptance, thereby potentially forcing the firm to raise its offer to avoid a costly conflict. Hence, the appointment of a more militant union leader serves as a credible, and visible, commitment on behalf of the union members to a relatively upbeat assessment of the outcome of arbitration, unless the wage offer is high enough for the union leader to endorse acceptance. This increase in bargaining power must be contrasted to the risks of imprecise information. What thus motivates the formal analysis is to figure out how the trade off between the two plays out, and under what circumstances, if any, the desire to increase the bargaining power also generates a risk of conflict in equilibrium.

The bargaining sub-game

In this subsection, the identity of the union leader is treated as given. This assumption is relaxed in the next subsection. To characterize the equilibrium of interest, some notation needs to be introduced. The union leader is indifferent between accepting or rejecting the wage offer if $w_o =$

$w_a - c_u$. Think of a strategy in which the union leader partitions the support of w_a in two parts, and then truthfully, though imprecisely, reveals in which of these two parts the point estimate of w_a lies. Let one part be all realizations for which the leader prefers to accept the wage offer, i.e. $w_a \in [0, w_o + c_u)$, and let the other be all realizations for which he prefers to strike, i.e. $w_a \in [w_o + c_u, 1]$. Note that this strategy can be thought of as an endorsement strategy; the partition carries the same information as a binary recommendation whether to accept the offered wage or not. I will therefore denote the former message as a_u, indicating that the union leader endorses (a for accept) the wage offer, and the latter as r_u, indicating that the leader recommends rejection. It is worth emphasizing again that actual union practices are consistent with this strategy. As pointed out in Undy and Martin (1984, p. 166), it is customary that the union leadership offers a binary recommendation when decisions are taken through ballots.

As discussed in the benchmark case, the w^H offer causes the union member's updated beliefs to take the form of an $h(\cdot)$ distribution that is truncated at the lower end of the support. This is also true for the message $\theta = r_u$. It follows that whenever the union member receives these two signals, the most informative of them, the signal that truncates the distribution the most, will be what guides her decision.[14] Which signal is the more informative, in turn, depends on c_f and c_u. If $c_f \leq -c_u$ then the firm's signal is more informative. If $c_f > -c_u$ then the union leader's signal is more informative. In the latter case, w^H as defined in equation (5) is no longer high enough to avoid a conflict when $\theta = r_u$. Instead, a threshold wage based on the union leader's signal must be defined. This threshold is denoted as $w^H(c_u)$, and it is defined as the value of w_o that satisfies the

[14] This result is equivalent to that received in multiple sender communication games where both senders have the same bias. See, for instance, Krishna and Morgan (2001a, 2001b) or Battaglini (2002).

following equality

$$w^H(c_u) = \int_{\max\{0, w^H + c_u\}}^{1} w_a \tilde{h}\left(w_a \mid \theta = r_u, w^H\right) dw_a - c_m, \tag{7}$$

where $\tilde{h}\left(w_a \mid \theta = r_u, w^H\right) = h(w_a)/1 - H\left(\max\{0, w^H + c_u\}\right)$. The notation $w^H(c_u)$ serves to distinguish the two cases, but also to highlight that w^H is now potentially a function of c_u. Note that $w^H(c_u)$ is decreasing as the union leader becomes more militant (as c_u is decreasing) since a rejection message now is less informative. To simplify the notation in what comes, the lowest wage offer that avoids a conflict when $\theta = r_u$ is defined as

$$\tilde{w}^H(c_u) = \max\left\{w^H(c_u), w^H\right\}. \tag{8}$$

Along a similar line, w^L must also be redefined for the case when $\theta = r_u$. The signal w^L potentially truncates the support of $h(\cdot)$ at the higher end of the support, whereas the signal $\theta = r_u$ potentially truncates the support at the lower end. Hence, in this case the signals are complementary in the sense that the two signals together define a more narrow band of potential realizations of w_a than any one signal alone. The value of w^L is now given by a wage offer that satisfies the following inequality

$$w^L < \int_{\max\{0, w^L + c_u\}}^{\max\{0, w^H - c_f\}} w_a \tilde{h}\left(w_a \mid \theta = r_u, w^L\right) dw_a - c_m, \tag{9}$$

where

$$\tilde{h}\left(w_a \mid \theta = r_u, w^L\right) = \frac{h(w_a)}{H\left(\max\{0, w^H - c_f\}\right) - H(\max\{0, w^L + c_u\})}. \tag{10}$$

Note that the union member would always be able to trust the advice of a union leader with preferences identical to her own. If she were to appoint a union leader with preferences different from hers, it must be to increase her bargaining power. This can only be done, though, by appointing a more militant union leader, i.e. a leader with a lower cost of conflict. Hence, it is clear that any

$c_u^* > c_m$ can be ruled out. To simplify the presentation I therefore restrict attention to the case when $c_u \leq c_m$.

Definition 1 *There exists a perfect Bayesian equilibrium such that:*

1) *The union leader truthfully signals whether he is in favour of accepting or rejecting the wage offer.*

$$\theta^*(c_u, w_o, w_a) = \begin{cases} a_u & if\ w_o \geq w_a - c_u \\ \\ r_u & if\ w_o < w_a - c_u \end{cases} \tag{11}$$

2) *The union member rejects or accepts the wage offer according to*

$$\sigma_m^*(c_u, c_m, w_o \mid \theta, w_o) = \begin{cases} a_m & if\ \{\theta = a_u, w_o \geq -c_u\} \\ \\ a_m & if\ \left\{\theta \neq a_u, w_o \geq \tilde{w}^H(c_u)\right\} \\ \\ r_m & otherwise \end{cases} \tag{12}$$

3) *The firm offers the lowest wage the union member accepts, unless it is better off going to arbitration.*

$$w_o^*(c_u, c_m, c_f, w_a) = \begin{cases} \min\left\{w_a - c_u, \tilde{w}^H(c_u)\right\} & if\ \min\{\cdot\} \leq w_a + c_f \\ \\ w^L & otherwise \end{cases} \tag{13}$$

4) *The union member updates her beliefs according to*

$$E[w_a \mid \theta, w_o] = \begin{cases} w_o + c_u & if\ \{\theta = a_u,\ w_o \in [-c_u, 1 - c_u]\} \\ \\ \int\limits_{\max\{0, w_o - \min\{c_f, -c_u\}\}}^{1} w_a \tilde{h}(w_a \mid \theta, w_o)\, dw_a & if\ \left\{\theta \neq a_u,\ w_o = \tilde{w}^H(c_u)\right\} \\ \\ \int\limits_{\max\{0, w_o + c_u\}}^{\max\{0, w^H - c_f\}} w_a \tilde{h}(w_a \mid \theta, w_o)\, dw_a & if\ \left\{\theta = r_u,\ w_o = w^L\right\} \\ \\ 1 & otherwise \end{cases} \tag{14}$$

The union member now receives two signals. Her basic motivation stays the same; she accepts the wage offer if and only if she thinks she would be worse off by going to arbitration. Her strategy changes, though, since she can now condition her actions on both signals. The firm's motivation is also unchanged; offer the lowest possible wage that will be accepted if that wage is lower than the cost of arbitration. It must now consider, though, the impact of its wage offer also on the strategy of the union leader, since the latter will influence the decision of the union member.

The union leader, on the other hand, takes the wage offer as given, but selects his message to maximize the chances that his preferred alternative is chosen. Information is soft in this case, so he is constrained in his ability to do this by the fact that his message must be deemed credible by the receiver. A standard result in the communication literature (e.g. Crawford and Sobel (1982)) is that there exists Bayesian equilibria in which the sender in his message partitions the state space of some variable x into N intervals, and where the receiver takes some optimal action y_n based on the message $x \in [x_{n-1}, x_n]$ for all $n \in \{1, 2, ...N\}$. In these equilibria, the sender is always indifferent between actions y_n and y_{n+1} at the breakpoint x_n. In the model presented in this paper, the receiver's strategy space is binary. It follows that there exists an equilibrium in which the state space is partitioned into at most two parts, as shown in equation (11). In this equilibrium the partition point is the realization of w_a such that the union leader is indifferent between an acceptance and a rejection of the wage offer. Hence, w_a is partitioned into $\{[0, w_o + c_u), [w_o + c_u, 1]\}$, and the union leader truthfully reports in which partition the actual realization lies. If this partition point falls outside the range $[0, 1]$, then there is no partition of the state space and the message carries no more information than what is already known. This corresponds to the endorsement strategy suggested above.

The firm's strategy now also depends on its impact on the union leader's signal. It follows from

the fact that any $c_u > c_m$ can be ruled out that any wage offer that invokes the union leader to report a_u will be accepted by the union member. The lowest such wage offer is given by $w_a - c_u$. This is not necessarily the lowest wage offer that will be accepted by the union member, though. If the leader is extreme enough relative to the union member, then there exists wage offers which the latter is willing to accept even though the former's advice is rejection. The lowest such wage offer is given by $\tilde{w}^H(c_u)$. It follows that the firm's optimal strategy is to offer $\min\{w_a - c_u, \tilde{w}^H(c_u)\}$ as long as this is weakly less than $w_a + c_f$, and w^L otherwise, as shown in equation (13).

The union member updates her beliefs based on the signals and what she knows about the players' strategies. As shown in the first row of equation (14), if $\theta = a_u$ then it follows from the firm's strategy that $w_a = w_o + c_u$. It also follows from the fact that $c_u \leq c_m$ that the union member knows that she is better off by accepting this offer.[15] If $\theta \neq a_u$ and $w_o = \tilde{w}^H(c_u)$ then the union member knows that w_a must be high enough to induce the leader to prefer rejection and the firm to be willing to offer $\tilde{w}^H(c_u)$. These signals both truncate the $h(\cdot)$ distribution at the lower end, and the relative size of c_u and c_f will determine which of them is more informative, yielding the expression in the second row of equation (14). It follows from the definition of $\tilde{w}^H(c_u)$ that such an offer will be accepted. Finally, if $\theta = r_u$ and $w_o = w^L$ then the signals are complementary, so the updated $h(\cdot)$ function is potentially truncated at both ends, as shown in row 3 of equation (14). Following the definition of w^L, this offer will be rejected though. For all other potential combinations of signals, the union member believes that $w_a = 1$.

To see how the expected wage offer depends on c_u, note that $w_a - c_u$ is increasing as the leader becomes more militant (lower c_u), whereas $w^H(c_u)$ is decreasing. The firm is better off by pleasing the union leader as long as $w_a \leq \tilde{w}^H(c_u) + c_u$, where the right hand side is increasing in c_u. It

[15] The condition that $w_o \in [-c_u, 1 - c_u]$ is made to rule out inconsistencies between the two signals, and no w_o outside of this range will ever be observed in equilibrium. Any w_o below $-c_u$ cannot induce $\theta = a_u$ for any realization of w_a within the permissible range $[0, 1]$. Any w_o above $1 - c_u$ is in excess of what the firm needs to pay to induce $\theta = a_u$ even when $w_a = 1$.

follows that the relationship between the expected wage offer and the militancy of the union leader is non-monotonic. At relatively high values of c_u (a moderate leader), a more militant union leader will increase the expected wage. The reason is that the probability that $w_a \leq \tilde{w}^H(c_u) + c_u$ is high, so the increasing effect through $w_a - c_u$ dominates the decreasing effect through $w^H(c_u)$. On the other hand, for low values of c_u (militant union leaders), the latter effect dominates, so the expected wage is decreasing with the militancy of the leader.

So far, the risk of a labour market conflict has not been addressed. A conflict occurs when $\min\left\{w_a - c_u, \tilde{w}^H(c_u)\right\} > w_a + c_f$. As long as $-c_u \leq c_f$ the firm is always willing to compensate the leader to signal acceptance, so no conflict occurs. If $-c_u > c_f$ then there is a conflict if the lowest wage the union member will accept after a message $\theta \neq a_u$ is higher than what the firm is willing to pay, i.e. if $w^H > w_a + c_f$.[16] Taken together these facts suggest that for a militant enough union leader there is potentially a risk of conflict at low realizations of w_a if c_m and c_f are not too high. These results are highlighted in the proposition below.

Proposition 1 *In the equilibrium defined above: 1) The relationship between the union member's expected wage and the militancy of the union leader is non-monotonic. For relatively moderate union leaders, the expected wage is increasing as the militancy of the leader is increasing. For relatively militant union leaders, the expected wage is decreasing as the militancy of the leader is increasing. 2) If $-c_u > c_f$ then there is a risk of conflict in equilibrium if $w^H > c_f$.*

Note that the results in Proposition 1 only refer to the bargaining sub-game, i.e. when the identity of the union leader is exogenously given. To see if there really is a risk of conflict in the equilibrium of the full game, it is necessary to also analyze the delegation decision.

[16] The condition $-c_u > c_f$ implies that it is the firm's rather than the leader's signal that is binding, so w^H is not a function of c_u.

The delegation stage

In this sub-section the identity of the union leader is endogenized. As discussed above, the reason why the leader's identity matters is because he influences the information on which the union member makes her decision. Contrary to most cases, having as precise and unbiased information as possible is not necessarily an advantage when engaged in bargaining, since information biased against acceptance may force the counterpart in the bargain to offer a better deal. It follows that the union member faces a trade-off between the inadequacy of information, and thereby the risk of making what ex post turns out to be an incorrect decision, and bargaining power.

Formally, the union member chooses the union leader whose information sharing strategy maximizes her expected payoff. The expression for the expected payoff, though, will depend on c_f and c_u. If $-c_u \leq c_f$ then the firm is always better off offering a wage high enough to be endorsed by the union leader. There is thus no risk of conflict, but the wage offer will depend on the realization of w_a. For low realizations of w_a the firm will offer a wage just high enough to guarantee an endorsement, but for higher realizations of w_a it becomes cheaper to please the union member despite the lack of endorsement from the leader. If $-c_u > c_f$ then the firm is never willing to offer a wage high enough to be endorsed by the union leader, so there is a risk of conflict for low realizations of w_a. For high realizations of w_a the firm is better off by offering a wage high enough to convince the union member to accept despite the lack of union leadership endorsement. The expression for the union member's expected payoff is given below.

$$U(\cdot) = \begin{cases} \int_0^{w^H(c_u)+c_u} (w_a - c_u)\, h(w_a)\, dw_a + \int_{w^H(c_u)+c_u}^1 w^H(c_u)\, h(w_a)\, dw_a & if \ -c_u \leq c_f \\ \int_0^{w^H-c_f} (w_a - c_m)\, h(w_a)\, dw_a + \int_{w^H-c_f}^1 w^H h(w_a)\, dw_a & if \ -c_u > c_f \end{cases} \tag{15}$$

An analysis of the payoff function yields the following results. The proof is in the appendix.[17]

[17] Uniqueness cannot be established for a general $h(\cdot)$ distribution, but it can be shown in the special case when

Proposition 2 *An equilibrium always exists to the delegation game. In this equilibrium the union member elects a leader who is more militant than herself but moderate enough to avoid the risk of conflict.*

The union member avoids a conflict by electing a union leader with $-c_u \leq c_f$. In the proof it is shown that the member is always strictly better off by choosing $c_u = -c_f$ than any leader who is more extreme, since a more militant leader incurs a risk of conflict with no advantage. However, this does not mean that it is necessarily optimal to set $c_u^* = -c_f$. If real authority was delegated then this would always be the optimal choice, and the union member would be able to extract all off the joint surplus. In this case, though, the firm has the ability to persuade the union members without convincing the union leader, and the more extreme is the latter the cheaper it is for the firm to convince the former even in the absence of an endorsement. The union member must thus consider the trade-off between these two effects in her choice of union leader, so she will generally appoint a union leader who is more militant than herself, but still moderate relative to what she would have done if the leader would have had real authority. Formally, $c_m > c_u^* \geq -c_f$, with a strict inequality if there exists an interior solution to the optimization of the first row of equation (15) within the permissible range. If not, then the maximization problem has a corner solution, so $c_u^* = -c_f$.

VI Wage Bargaining and Strikes

So far it has been assumed that the realization of c_f is common knowledge. It is probably more realistic to assume that union members are uncertain of the firm's cost of conflict. Uncertainty of this kind has been shown to be an important assumption driving conflicts in other wage setting

$h(\cdot)$ is uniform.

models (e.g. Hayes, 1984, and Kennan and Wilson, 1993). Also within the more general theory literature, it is well known that there will be inefficient outcomes in bilateral trade if the valuation of the good to be traded is private information and there are realizations where no trade is the efficient outcome, i.e. realizations such that the seller values the good higher than the buyer (e.g. Myerson and Satterthwaite 1983). It should be noted though that there is always a non-empty contract zone between the decisive union member and the firm in my model (trade is always the efficient outcome), and inefficient outcomes are not inevitable, they are part of a deliberate choice.

Private information will not change strategies in the bargaining sub-game, but it may influence expectations, and thereby the representation of w^H and w^L, and the delegation decision. To calculate beliefs based on the firm's signal is now complicated by the fact that the union member is uncertain not only of w_a but also of c_f. It follows that the probability that w_a takes on a certain value now takes the form of a conditional joint probability, and, ignoring the signal from the union leader for now, the expected value of w_a based on the signals w^H and w^L, can be written as

$$E[w_a \mid w_o] = \begin{cases} \int_0^{w_o} w_a \frac{h(w_a)[1-G(w_o-w_a)]}{\left[\int_0^{w_o} h(w_a)[1-G(w_o-w_a)]dw_a + \int_{w_o}^1 h(w_a)dw_a\right]} dw_a + \\ \int_{w_o}^1 w_a \frac{h(w_a)}{\left[\int_0^{w_o} h(w_a)[1-G(w_o-w_a)]dw_a + \int_{w_o}^1 h(w_a)dw_a\right]} dw_a & \text{if } w_o = w^H \\ \\ \int_0^{w^H} w_a \frac{h(w_a)G\left(w^H-w_a\right)}{\left[\int_0^{w^H} h(w_a)G(w^H-w_a)dw_a\right]} dw_a & \text{if } w_o = w^L \end{cases} \tag{16}$$

As in the previous cases, w^H can be defined as

$$w^H = E[w_a \mid w^H] - c_m, \tag{17}$$

and w^L as some value w_o satisfying the inequality

$$w^L < E[w_a \mid w^L] - c_m. \tag{18}$$

The existence of a fixed point satisfying the equality in equation (17) can be verified by the same logic applied in the previous section. I assume that the $h(\cdot)$ and $g(\cdot)$ distributions are such that

the fixed-point is unique.

Taking both signals into consideration, once again the firm's signal is binding only as long as the union leader is sufficiently militant, whereas the union leader's rejection signal is binding if the leader is relatively moderate. When the realization of c_f was common knowledge, then this cutoff was simply given by $-c_u = c_f$. When c_f is private information, then no such closed form solution in terms of c_u can be derived for general distributions, due to the complexity of equation (16). Instead a general cutoff value $\tilde{c}_u$ is defined by the cost of conflict at which the required wages are identical, i.e. at $w^H = w^H(c_u)$.

In a similar way, w^L must now be defined taking both signals into consideration. In this case the two signals truncate the support of $h(\cdot)$ at different ends, so the signals are complementary rather than substitutes. The low wage is then given by a value of w^L that satisfies the following inequality

$$w^L < \int_{\max\{0, w^L + c_u\}}^{w^H} w_a \frac{h(w_a) G\left(w^H - w_a\right)}{\left[\int_0^{w^H} h(w_a) G(w^H - w_a) dw_a\right]} dw_a - c_m. \tag{19}$$

Turning to the delegation stage, the expected payoff over different intervals of c_u can now be expressed as

$$U(\cdot)=\begin{cases}\int_{0}^{w^{H}(c_u)+c_u}(w_a-c_u)\,h(w_a)\,dw_a+\int_{w^{H}(c_u)+c_u}^{1}w^{H}(c_u)\,h(w_a)\,dw_a \\ \qquad if\ c_u\geq 0 \\ \int_{0}^{-c_u}\left[\int_{0}^{w^{H}(c_u)-c_f}(w_a-c_m)\,h(w_a)\,dw_a+\int_{w^{H}(c_u)-c_f}^{1}w^{H}(c_u)\,h(w_a)\,dw_a\right]g(c_f)\,dc_f+ \\ \int_{-c_u}^{1}\left[\int_{0}^{w^{H}(c_u)+c_u}(w_a-c_u)\,h(w_a)\,dw_a+\int_{w^{H}(c_u)+c_u}^{1}w^{H}(c_u)\,h(w_a)\,dw_a\right]g(c_f)\,dc_f \\ \qquad if\ c_u\in(\tilde{c}_u,0) \\ \int_{0}^{-c_u}\left[\int_{0}^{w^{H}-c_f}(w_a-c_m)\,h(w_a)\,dw_a+\int_{w^{H}-c_f}^{1}w^{H}h(w_a)\,dw_a\right]g(c_f)\,dc_f+ \\ \int_{-c_u}^{1}\left[\int_{0}^{w^{H}+c_u}(w_a-c_u)\,h(w_a)\,dw_a+\int_{w^{H}+c_u}^{1}w^{H}h(w_a)\,dw_a\right]g(c_f)\,dc_f \\ \qquad if\ c_u\leq\tilde{c}_u\end{cases} \tag{20}$$

The following proposition is proved to hold true in the appendix.

Proposition 3 *There always exists an equilibrium to the delegation game when the realization of c_f is private information. If $h(\cdot)$ and $g(\cdot)$ are uniform, then there is a risk of conflict in equilibrium whenever $c_m<1/4$.*

Uncertainty about the realization of c_f smooths out the value function making it continuous in c_u throughout the full support which guarantees the existence of an equilibrium. As in the previous section it is possible to show that the union member always appoints a leader who is more conflict prone than herself but to be able to say something about the risk of conflict I must be more specific about the probability distributions. A conflict occurs with positive probability if $c_u^*<0$. It is

shown in the appendix that when $g(\cdot)$ and $h(\cdot)$ are uniform then the union member indeed elects a leader with a negative cost of a conflict whenever $c_m \in (0, 1/4)$. Note that the risk of conflict is not necessary for the union member to reap part of the surplus, that can be achieved also by setting $c_u = 0$. The result is thus not just a trivial consequence of the fact that the firm can hold the union member at his reservation utility in the ultimatum game.

To sum up, what this subsection shows is that when the firm's cost of conflict is private information, then conflicts may arise in equilibrium. This is consistent with the results from screening models where conflicts serve as an instrument to extract information, even though the mechanism here is different. In this equilibrium inefficiencies arise even though all players know that the contract zone between the firm and the union member is never empty, and, in particular, even though the union member has the option to get sufficiently informed to always avoid a conflict and still receive part of the common surplus.

VII Discussion

The benefit of a more militant union leader is that he forces the firm to offer a higher wage in order to avoid a strike. Once the wage is offered, though, union members would prefer to have precise information. Acquiring this would undermine the mechanism of the model, however, since the firm, realizing what is going on, would see no need to offer any wage higher than the union member's reservation wage. It is thus a crucial assumption that the union member cannot somehow, through carrot or stick, induce the union leader to reveal more precise information once the wage is offered. In principle, union members could offer temptation in the form of economic compensation, or threaten the union leader with economic sanctioning or firing, in order to get more precise information. There are several good reasons to doubt that this will happen, though. Financial

compensation and other employment conditions of the union leader are generally determined in employment contracts specified ex ante, i.e. at a time when the union members, if anything, would like to commit not to ask for additional information. Compensation or punishment must thus go beyond what is specified in any contract. One such means would be to threaten to fire the union leader. However, as pointed out in Undy and Martin (1984), union leaders are usually appointed for 5 or 3 year terms, so that is unlikely to happen. Furthermore, union members would have incentives to appoint an identical union leader again for the next round of negotiations. The union leader has been chosen to do exactly what he is doing, so once the arbitration has been settled and union members look forward to the next round of negotiations, they would have no incentives to carry through with their threat to fire him.

On the other hand, is it not possible that even if real authority on paper is assigned to the rank-and-file, in practice authority still rests with the union leadership? That is, cannot union members simply commit to always follow the recommendation? This is not very plausible from a theoretical perspective; rational individuals should want to consider all available information before making their decision and it is hard to see how they could commit not to. More importantly, though, it seems inconsistent with observed union behaviour. As pointed out in Undy and Martin (1984), recommendations from the leadership are accepted more frequently than they are rejected, but rejections are not unheard off. For instance, out of the 11 ballots on wage offers to the National Union of Mineworkers between 1969-1982, a majority of the rank-and-file voted 3 times to accept the offer even though the leadership recommended a strike on all these occasions (Undy and Martin, 1984, p. 134). A more recent example is that of British postal workers rejecting a strike endorsed by the union leadership in September 2003 (The Financial Times, 2003). Hence, in accordance with my model, union members usually follow the recommendation of their leadership, but not always.

One outcome seen in the real world that does not arise in the model is when the union leader recomends that a wage offer be accepted, but union members still vote to go to strike. This would suggest that the union leader is less strike prone than the median voter within the union, or alternatively that there is a different strategic motive at play or sources of assymetric information beyond what is part of this model. A relatively straightforward way to incorporate this possibility into the current model would be to assume that union members, at the time of elections, have incomplete information about the preferences of candidates running for union leadership (i.e. they chose between distributions of c rather than exact values on c). As time goes by union members learn about the type of their leader so there is a risk they end up realizing that the union leader is much less strike prone than what they had expected once wage negotiations start. In particular, if the leader ends up being less strike prone than the median voter within the union, then a strike against the leader's recomendation can be the outcome.[18]

It should be emphasized that the argument made in this paper is not that a legislative change that transfers real authority from the union leadership to the rank and file will have no effect on the power of the union. Letting union members delegate real authority in this model leads to a more extreme union leader, a higher expected wage offer and a higher risk of strike in equilibrium (when c_f is private information). Rather, the arguments are that the union can still retain some power and the legislative change does not fully eliminate neither the incentives to elect more extreme union leaders nor the risk of strikes. The aforementioned reduction in (but not elimination of) the number of strikes in Britain is thus fully consistent with the predictions of the model, as are papers based on Canadian data showing that mandatory strike votes reduce the incidence as well as duration of strikes (Gunderson and Melino, 1990, and Cramton et al, 1999).

[18]The uncertainty can also come from a risk that the union leader will "sell out" to the firm management as their interaction becomes more frequent. Indeed, Ashenfelter and Johnson (1969) discuss how union leaders may face a choice between accepting a wage offer below what the rank and file expected, or calling a strike, when they have no credible way to communicate what is a reasonable expectation.

VIII Concluding Remarks

In this paper, a wage bargaining model with private information and signaling is developed. In contrast to previous models the main focus has been on communication within the union, rather than on costly signals between the union and the firm. Existing legislation, stipulating union-wide ballots on both wage offers and the identity of the union leadership, has undermined the real authority of union bosses. The argument made in this paper, though, is that leaders can still wield substantial powers through their superior access to information relevant for the rank-and-file's decisions. The union boss thus serves as an expert, or agitator, strategically disseminating information to try to persuade the members to take a certain action.

The analysis shows that more militant bosses will bias information in order to persuade the union members to require a higher wage. From the union members' perspective, though, this is an opportunity, because in the equilibrium analyzed a militant union boss can serve as a commitment device to an information set that increases their bargaining power. The threat of lack of endorsement from the union leadership only helps as long as communication is credible though, and a recommendation to reject the wage offer is less likely to be followed if it is received from a very militant leader. The relationship between bargaining power and the militancy of the union leader is thus non-monotonic, suggesting that the optimal union leader will be more strike prone than a majority of union members, but not an extremist. In normative terms, the model suggests that there may be a risk of conflict in equilibrium despite that it is common knowledge that the contract zone between the actual decision maker within the union and the firm is never empty. Hence, union-wide ballots are no panacea for inefficient conflicts.

Starting from Schelling (1956), the bargaining literature is full of references to the potential strategic benefits of commitment and the role of information and signaling. Commitment has been

modelled as delegation of real authority to a third player or by some kind of investment (it could be real or it could be reputational) that makes defection from an announced decision rule costly. Signaling has been modeled between the firm and the union, and in the form of costly signals rather than communication. However, I argue in this paper that signaling also takes place within the union and that this is crucial for the formation of the union members' expectations of the wage bargaining outcome. Furthermore, I show that even though union members may not be able to delegate real authority they can still reap benefits of commitment by influencing information flows through their choice of union leader. The main contribution of this paper is thus that it offers a new perspective on how signalling and commitment can increase union members' bargaining power.

A Appendix

Proof of Proposition 2

The payoff function from equation (15) is replicated below.

$$U(\cdot) = \begin{cases} \int_0^{w^H(c_u)+c_u} (w_a - c_u)\, h(w_a)\, dw_a + \int_{w^H(c_u)+c_u}^1 w^H(c_u)\, h(w_a)\, dw_a & if \ -c_u \leq c_f \\ \int_0^{w^H-c_f} (w_a - c_m)\, h(w_a)\, dw_a + \int_{w^H-c_f}^1 w^H h(w_a)\, dw_a & if \ -c_u > c_f \end{cases} \tag{A1}$$

Existence: The payoff function is continuous in c_u except for a discrete jump at $-c_u = c_f$. Moreover, the payoff is independent off c_u whenever $-c_u > c_f$. It follows that a sufficient condition for the existence of an equilibrium is that the discrete jump decreases the payoff at the point $-c_u = c_f$ when moving in the direction of a more militant union leader. Substituting $-c_u$ for c_f in equation (A1) shows that the only remaining difference between the two equations is c_u rather than c_m in the first integral. It follows from the fact that $c_u < c_m$ when evaluated at $-c_u = c_f$

that the discrete change is decreasing the payoff.

Risk of conflict in equilibrium: Conflict can only occur in equilibrium if $c_u^* < -c_f$. This possibility was ruled out above.

Identity of the optimal union leader: No closed form solution for the identity of the union leader can be derived without specific assumptions about the shape of the $h(\cdot)$ distribution. However, it can be proved that $c_u^* < c_m$ by showing that the first derivative of equation (A1) is strictly negative when evaluated at $c_u = c_m$. This first derivative is given by

$$\left[\frac{\partial w^H(c_u)}{\partial c_u} + 1\right] w^H(c_u) - \int_0^{w^H(c_u)+c_u} h(w_a)\, dw_a$$
$$- \left[\frac{\partial w^H(c_u)}{\partial c_u} + 1\right] w^H(c_u) + \int_{w^H(c_u)+c_u}^{1} \frac{\partial w^H(c_u)}{\partial c_u} h(w_a)\, dw_a. \tag{A2}$$

This can be simplified to

$$- \int_0^{w^H(c_u)+c_u} h(w_a)\, dw_a + \int_{w^H(c_u)+c_u}^{1} \frac{\partial w^H(c_u)}{\partial c_u} h(w_a)\, dw_a. \tag{A3}$$

To evaluate this at $c_u = c_m$, remember first that $w^H(c_u)$ in this case is defined by

$$w^H(c_u) = \int_{\max\{0, w^H + c_u\}}^{1} w_a \tilde{h}\left(w_a \mid \theta = r_u, w^H\right) dw_a - c_m. \tag{A4}$$

Evaluated at $c_u = c_m$, the solution to this equality is given by $w^H = 1 - c_m$. This is so because as $c_u -> c_m$ from below, the union member will require a higher and higher wage offer to go against the recommendation of the leader, and in the limit the wage offer has to yield a utility as high as the highest possible utility in arbitration, $1 - c_m$. Plugging in $w^H = 1 - c_m$ into equation (A3) and replacing c_u with c_m yields

$$-\int_0^1 h(w_a)\, dw_a < 0. \tag{A5}$$

Proof of Proposition 3

Existence: Introducing uncertainty regarding the realization of c_f has the attractive feature that it makes the expected payoff continuous in c_u throughout the full support, i.e. existence is guaranteed. To see this, plug in the threshold values between the intervals into the corresponding payoff functions and note that the equations are identical at those points. Setting $c_u = 0$ in the second part of equation (20) yields exactly the first part of equation (20), while setting $c_u = \tilde{c}_u$ in the third part of equation (20) yields exactly the second part, since $\tilde{c}_u$ is defined as the leader for which $w^H(c_u) = w^H$.

Identity of the optimal union leader when $h(\cdot)$ and $g(\cdot)$ are uniform: Solving for $w^H(c_u)$ when $h(\cdot)$ is uniform yields

$$w^H(c_u) = 1 + c_u - 2c_m. \tag{A6}$$

Plugging this into equation (20) and solving the first order condition for c_u yields that

$$c_u^* = c_m - \frac{1}{4}. \tag{A7}$$

This interior solution only falls within the permissible range when $c_m \geq 1/4$. Whenever $c_m < 1/4$, then the preferred union leader within this set of types corresponds to the corner solution, $c_u^* = 0$, and payoff is monotonically decreasing as c_u is increasing.

Equation (20) is not globally concave in c_u, but it is locally concave within the permissible range, $c_u \in (\check{c}_u, 0)$. The first order condition can be developed as a second order equation, for which the larger root is a max-point while the smaller root is a min-point. The larger root of the solution is given by

$$c_u^* = -\frac{(6-2c_m)}{10} + \frac{\sqrt{\left(\frac{(6-2c_m)}{5}\right)^2 - \frac{4}{5}\left(4(c_m)^2 - 5c_m + 1\right)}}{2} \tag{A8}$$

Setting equation (A8) less than or equal to zero and solving for c_m yields $c_m \leq 1/4$. Hence,

$c_u^* \leq 0$ as long as $c_m \leq 1/4$. As c_m is decreasing, so is c_u^*, and when $c_m = 0$ then $c_u^* = -1/5$. This will only be a potential equilibrium, though, as long as c_u^* falls within the permissible range, i.e. if $c_u^* \in (\tilde{c}_u, 0)$. The lower limit is defined as the c_u such that

$$w^H = w^H(c_u). \tag{A9}$$

With a uniform distribution, this can be simplified as

$$\tilde{c}_u = 2c_m + w^H - 1, \tag{A10}$$

and w^H can be developed as the solution to

$$c_m = \frac{6 - 2\left(w^H\right)^3}{6\left(2 - w^H\right)} - w^H. \tag{A11}$$

Solving numerically for $c_m \in [0, 1/4]$ in equations (A10) and (A11) yields values of $\tilde{c}_u \in [-0.32, -0.15]$. Most importantly, $\tilde{c}_u$ is smaller than c_u^* for all $c_m \in [0, 1/4]$.

The logic above implies that $c_u^* < 0$ whenever $c_m < 1/4$, i.e. that there will be a positive probability of conflict in equilibrium whenever $c_m < 1/4$. It does not necessarily imply, though, that the solution to equation (A8) represents the optimal union leader. It may be the case that a more militant leader with $c_u < \tilde{c}_u$ yields a higher expected payoff. Comparing the second and third representations of payoff in equation (20) shows that there are two effects of choosing a more militant union leader that are unique to the first case, i.e. when w^H is a function of c_u. The first is that a more militant union leader will decrease the probability that $w_a < w^H(c_u) - c_f$. It follows that the increased risk of conflict that comes with a more militant union leader is mitigated in this case. This effect thus goes completely against the idea that there may exist a $c_u < \tilde{c}_u$ that is preferred to c_u^* as expressed in equation (A8). But, the other difference is that the compensation when w^H is binding is increasing with c_u when $c_u \in (\tilde{c}_u, 0)$, but independent of c_u when $c_u < \tilde{c}_u$.

This implies that the cost of choosing a more militant union leader is smaller when $c_u < \tilde{c}_u$, i.e. this effect goes the other way. Which of the two effects is dominating cannot be determined analytically. The important thing, though, is that there exists an equilibrium and that when $c_m \in [0, 1/4]$ then the equilibrium entails a risk of conflict.

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