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Strategic Delegation and Delay in Negotiations over the Bargaining Agenda

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This paper develops a game-theoretic model that endogenizes the items included in the bargaining agenda. The model's equilibria suggest two possible sources of inefficiency: (1) exclusion of items from the bargaining agenda and (2) delay to agreement due to negotiations over the bargaining agenda. Evidence from union contract negotiations is provided to demonstrate the relevance of these sources of inefficiency. The model also allows strategic delegation by the union. In certain equilibria, the surplus-maximizing union selects wage-maximizing delegates (such as senior union members) to negotiate the contract.

I. Introduction

The empirical evidence is mixed on whether union labor contracts result in employment levels where the marginal revenue product of labor equals the reservation wage of labor (see Brown and Ashenfelter 1986; MaCurdy and Pencavel 1986; and Svejnar 1986). Contracts that result in the marginal revenue product being greater than the reservation wage are inefficient. This occurs if the contract allows the firm to select employment level and specifies a marginal cost of labor that is greater than the

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labor's reservation wage.[1] If the marginal cost of labor is greater than the reservation wage, efficiency can be achieved if the contract specifies employment level.

This article provides an explanation for why the outcome of union contract negotiations may be inefficient by endogenizing the items included in the bargaining agenda. We restrict the bargaining agenda to include only wage rate or wage rate and employment level. The intuition for why employment level may be excluded from the bargaining agenda, even though total surplus would be greater if it was included, is that the union and firm realize that a lower wage rate increases employment, and the firm can use this fact to capture more of the surplus. As Dowrick (1990) demonstrates, this may result in the firm's surplus being greater when only wage rate is negotiated, even though total surplus is less, compared to when the wage rate and employment level are negotiated. We identify equilibria that are inefficient because employment level is excluded from the bargaining agenda, and the agreed upon wage rate is greater than the union members' reservation wage. In addition, there exist inefficient equilibria where employment level is specified in the contract, but agreement is delayed due to negotiations over the bargaining agenda. Finally, we allow the surplus-maximizing union to strategically delegate contract negotiations to either surplus-maximizing or wage-maximizing individuals (see Fershtman and Judd 1987). Under certain conditions, the union would select wage-maximizing delegates to negotiate the contract, such as senior people who have no fear of being laid off.

We construct a three-stage game to investigate how the bargaining agenda is determined and whether the surplus-maximizing union has incentive to select wage-maximizing delegates. In the first stage, the union selects either wage-maximizing or surplus-maximizing delegates to negotiate with the firm. The firm and the union then bargain in the second stage over the set of parameters to be negotiated (i.e., bargaining agenda). This is followed by the third stage in which they bargain over the specific value(s) of the agreed-upon parameter(s).[2] We find that the subgame

[1] If the firm selects employment level, the marginal cost of labor equals the wage, and the wage equals the labor's reservation wage, then the efficient level of labor is employed, and the union members obtain zero surplus. Hall and Lilien (1979) and Kuhn (1988) demonstrate that an efficient contract can be achieved when the firm selects employment level if the union contract specifies quantity discounts on labor and a seniority hiring rule that implements the discounts.

[2] We assume that negotiations over the bargaining agenda occur prior to negotiations over specific values of those items included in the bargaining agenda. This sequencing is supported by Walton and McKersie's classic 1965 book titled *A Behavioral Theory of Labor Negotiations.* In addition, our discussions with individuals who negotiate union contracts also suggest that this type of sequence is common. The lead negotiator for Elliott Company (a turbine and compressor

perfect equilibria depend on the firm's market demand curve. In certain circumstances, the union selects wage-maximizing delegates, and agreement is reached without delay. If this is the case, whether or not the employment level is included in the negotiation agenda will not be an issue since it will not affect the bargaining frontier. In other circumstances, the union selects surplus-maximizing delegates, and negotiations may or may not include employment level. Delay to agreement can occur with surplus-maximizing delegates.

The article considers subgame perfect equilibria and is organized in the following manner. Section II presents the basic model, where the firm and union's objective is to maximize their individual surplus. Section III considers the subgame where the objective of the union delegates is to maximize the union's surplus, followed by Section IV, which considers the subgame where the union delegates' objective is to maximize the wage rate. Section V compares outcomes for these two subgames to determine which type of delegates the union selects. Section VI considers the empirical relevance of the model, using evidence from specific union contract negotiations, and Section VII concludes. Proofs of lemmas and propositions are relegated to the appendix.

II. The Environment of the Model

A firm produces a good whose only input is labor. The wage rate depends on the contract negotiated between the firm and the union delegates. We assume for simplicity that each unit of output can be produced by one unit of labor. Let q denote the quantity of labor employed by the firm, which of course equals the output level. Letting $P(q)$ denote a strictly decreasing inverse demand function, the firm's revenue from selling q units of the good can be written as $R(q) = P(q)q$. We assume that the marginal revenue is decreasing in employment level, that is, $R''(q) = 2P'(q) + P''(q)q < 0$, which is satisfied if $P''(q) \leq 0$. The firm's objective function is its surplus, which is nothing but its profits: $S_F(w, q) = R(q) - wq$, where w denotes the wage rate. The union's objective function is total wages earned by union members, $S_U(w, q) = wq$. Notice that we normalize P and w so that the reservation wage of the workers equals zero.[3]

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manufacturer outside of Pittsburgh), in their contract negotiations with Locals 1145 and 2380 of the United Steelworkers of America (USWA), states that the first step in their negotiations is to identify the agenda to be bargained (such as cost of living adjustments, safety issues, health benefits, job security, job scope, and wages).

[3] Without loss of generality, we normalize the price and wage rate so that $P(q)$ and w represent their actual values minus the reservation wage rate. To see this

The wage rate and possibly employment level are determined by negotiations between the firm and the union delegates. Preceding the negotiations, the union may affect the negotiation outcome by selecting delegates whose objective is to maximize the union's surplus or maximize the wage rate.

In either case, the firm and the union delegates then discuss whether the employment level as well as the wage rate will be negotiated. This is modeled as a war of attrition in continuous time. Once the firm and union delegates agree on the negotiation agenda, they select the specific value(s) of the agreed upon parameter(s) in the agenda, resorting to the Nash bargaining solution. We interpret the Nash bargaining solution as the limit of the subgame perfect equilibrium of the Rubinstein (1982) bargaining model when the lag between offers converges to zero (see Binmore 1986 for the proof).

III. The Negotiation between the Firm and Surplus Maximizing Union Delegates

This section considers the case in which the union sends delegates whose interest is the same as the union's (i.e., maximizing union surplus). First, we derive the Nash bargaining solutions when negotiations are only over the wage rate and when negotiations are over both wage rate and employment level. In terms of the notation, variables will be superscript with "*" when only wage rate is negotiated and with "**" when both wage rate and employment level are negotiated. Using the payoffs associated with the Nash bargaining solutions, we then identify the equilibrium actions when deciding on the negotiation agenda (i.e., what parameters are to be negotiated).

Consider the case in which the firm and union delegates negotiate only over the wage rate. Once they agree on a particular wage rate, the employment level is determined so as to maximize the firm's surplus. Thus, given an agreed-upon wage rate w^*, the employment level $q^*(w^*)$ is determined by the first order condition:

$$R'(q^*(w^*)) = w^*. \tag{1}$$

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normalization further, let us define $\hat{P}(q)$, $\hat{w}$, and w_R as actual values of the price, wage rate, and the reservation wage rate, respectively. Then the firm's actual profits are $\hat{P}(q)q - \hat{w}q$. However, since $\hat{P}(q) = P(q) + w_R$ and $\hat{w} = w + w_R$, the firm's actual profits can be written as $P(q)q - wq$, which equals $S_F(w, q)$. As for the union's objective function, we specify it as the union's total wages, which can be thought as a "utilitarian" objective function (Farber 1986). Letting L denote the total number of union members, it is given by $\hat{w}q + w_R(L - q)$. However, it can be reduced to $wq + w_R L$, which is $S_U(w, q)$ plus a constant.

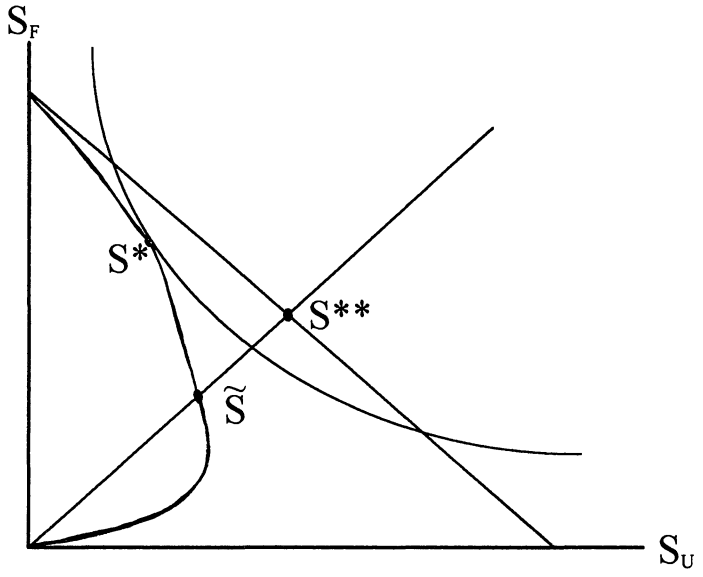

FIG. 1.—Nash bargaining solutions

Letting $S_F^* = S_F(w^*, q^*(w^*))$ and $S_U^* = S_U(w^*, q^*(w^*))$, the following lemma states that the firm's surplus is greater than the union's surplus in the Nash bargaining solution.

LEMMA 1.—The Nash bargaining solution, when the firm and the surplus-maximizing union delegates negotiate only over the wage rate, is such that $S_F^* > S_U^*$.[4]

Lemma 1 is different than the typical Nash bargaining solution where the risk-neutral buyer and seller split the surplus evenly. The reason the firm's surplus is greater than the union's surplus in this case is because total surplus is a function of the wage rate. The two parties realize that a lower wage rate increases the quantity of labor the profit-maximizing firm employs, and an increase in the employment level benefits the union. The feasible set and the Nash bargaining solution, $S^* = (S_U^*, S_F^*)$, are depicted in figure 1. The feasible set obviously depends on the function $R(q)$.

Now consider the case where the set of parameters they negotiate expands to include the employment level in addition to the wage rate.

[4] Lemmas 1 and 2 do not have significant implications in themselves since the results from the comparison between the two parties' surpluses are vulnerable to linear transformation. However, they help prove proposition 1, which is robust to linear transformation of these surpluses.

Letting (w^{**}, q^{**}) be the agreement, we can express the resulting surpluses as $S_F^{**} = S_F(w^{**}, q^{**})$ and $S_U^{**} = S_U(w^{**}, q^{**})$, respectively. The following lemma states that the Nash bargaining solution in this case results in their surpluses being equal.

LEMMA 2.—The Nash bargaining solution, when the wage rate and employment level are negotiated, is such that $S_F^{**} = S_U^{**}$. The employment level is such that the marginal revenue product of labor equals zero, which is the reservation wage rate of union workers.

The bargaining frontier in this case is linear and depicted in figure 1. At each point on the bargaining frontier the quantity of labor the firm employs is q^{**}, where $R'(q^{**}) = 0$. Total surplus is maximized on the bargaining frontier, and this occurs when the marginal revenue product of labor equals the union's opportunity cost. The Nash bargaining solution is such that $w^{**} = R(q^{**})/2q^{**}$, and is depicted by $S^{**} = (S_U^{**}, S_F^{**})$ in figure 1.

Whether the firm and union prefer to negotiate over only the wage rate or the wage rate and employment level depends on how their surpluses compare across the two cases. Proposition 1 states that the union prefers to negotiate over both wage rate and employment level while the firm's preference depends on the function $R(q)$.

PROPOSITION 1.—The following results are obtained by comparing the Nash bargaining solution when negotiations are only over the wage rate to the Nash bargaining solution when negotiations are over the wage rate and employment level: (i) $S_U^* < S_U^{**}$, and (ii) depending on $R(q)$, S_F^* can be greater than, equal to, or less than S_F^{**}. However, $S_F^* > S_F^{**}$ if $R'''(q) \leq R''(q)^2/R'(q)$, which in turn is satisfied if $R'''(q) \leq 0$.

A sufficient condition for $S_F^* > S_F^{**}$ is that $R'''(q) \leq 0$. Since $R'(q)$ represents the marginal revenue for the firm, the condition is equivalent to the marginal revenue curve being weakly concave. Under such circumstances, there are conflicting interests between the firm and union delegates in terms of the set of parameters to be negotiated.[5]

Let us turn to the stage of the game where the firm and union delegates determine the set of parameters to be negotiated.

If $R(q)$ is such that $S_F^* \leq S_F^{**}$, then both firm and union weakly prefer to negotiate over the wage rate and employment level. The unique subgame perfect-equilibrium outcome has no delay until agreement and both wage rate and employment level are negotiated. Therefore, explicit negotiation yields an efficient outcome. The agreement is such that $S_F(w^{**}, q^{**}) = S_U(w^{**}, q^{**})$ and $R'(q^{**}) = 0$ (see lemma 2).

[5] Suppose that the firm faces an inverse demand function of $P(q) = a - bq^c$, where $a > 0$, $b > 0$ and $c \geq 1$; its total cost is wq. Then it is readily verified that $R'''(q) = -bc(c^2 - 1)q^{c-2} \leq 0$. In this case, $S_F^* > S_F^{**}$.

If $S_F^* > S_F^{**}$, there are conflicting interests between the firm and union delegates. The firm prefers to negotiate over only the wage rate, and the union delegates prefer to negotiate over the wage rate and employment level. At any point in time, each party decides whether or not to concede. Under these circumstances, there are numerous subgame perfect equilibria. However, there are only three stationary ones. First, the strategy profile where the union delegates never agree to negotiate over only the wage rate, and the firm always agrees to negotiate over the wage rate and employment level, is a subgame perfect equilibrium of this subgame. The outcome of this equilibrium has no delay to agreement and has both wage rate and employment level being negotiated. An outcome of no delay and only the wage rate being negotiated occurs if the subgame perfect equilibrium is such that the firm never agrees to negotiate over the wage rate and employment level, and the union delegates always agree to negotiate over only the wage rate. Another stationary equilibrium has both parties randomizing at any moment between agreeing to negotiate over the wage rate and agreeing to negotiate over the wage rate and employment level. As shown in the appendix, the union delegates are indifferent if the firm's hazard rate associated with agreeing to negotiate over both wage rate and employment level is $rS_U^*/(S_U^{**} - S_U^*)$, where r is a common discount rate. The firm is indifferent if the union delegates' hazard rate associated with agreeing to negotiate over only wage rate is $rS_F^{**}/(S_F^* - S_F^{**})$.[6] Any delay to agreement occurs as a result of deciding which parameters are to be negotiated. Once the parameters are decided, agreement occurs immediately.

PROPOSITION 2.—There are three possible stationary subgame perfect-equilibrium outcomes for the subgame with surplus-maximizing delegates: (i) The firm and union immediately agree to negotiate over both wage rate and employment level and select (w^{**}, q^{**}) immediately by negotiation; (ii) the firm and union immediately agree to negotiate over only the wage rate and select w^* immediately by negotiation; (iii) both the firm and union concede to each other stochastically. The firm's hazard rate associated with agreeing to negotiate over the wage rate and employment level is $rS_U^*/(S_U^{**} - S_U^*)$, while the union delegates' hazard rate

[6] It is interesting to note that the union's hazard rate is greater than the firm's hazard rate. This holds because $S_F^* > S_U^*$, $S_F^{**} = S_U^{**}$, and $S_F^{**} + S_U^{**} > S_F^* + S_U^*$ (see lemmas 1 and 2). It must therefore be the case that $S_U^{**} - S_U^* > S_F^* - S_F^{**}$, and $S_F^{**} > S_U^*$. The intuition behind this result is that the benefit to the firm of the union conceding is less than the union's benefit if the firm concedes. In addition, the cost of not conceding is greater for the firm than the union. Thus, to make the other party indifferent between conceding and not conceding, the union's hazard rate must be greater than the firm's hazard rate.

associated with agreeing to negotiate over only the wage rate is $rS_F^{**}/(S_F^* - S_F^{**})$.

Regardless of the function $R(q)$, the first outcome can be supported by a subgame perfect equilibrium. If $R'''(q) \leq 0$, any of the three outcomes can be supported by a subgame perfect equilibrium. Equilibrium outcomes (ii) and (iii) are inefficient in that total surplus is not maximized. If $R(q)$ is such that the firm prefers to negotiate over only the wage rate rather than the wage rate and employment level, the equilibrium outcome may be inefficient due to negotiating over only the wage rate. Moreover, equilibrium outcome (iii) indicates that even if wage rate and employment level are negotiated, there may be delay to an agreement, which is another source of reducing the total surplus. Indeed, since each party is indifferent between conceding and not conceding at any moment in the first stage of the game, the expected payoff vector is (S_U^*, S_F^{**}), which may lie strictly inside the feasible set when only the wage rate is determined in the negotiation. Which of these equilibrium outcomes prevail is likely to depend on prior negotiations between the union and the firm as well as recent negotiations between the union and other firms in the industry (if pattern bargaining is prevalent).

IV. The Negotiation between the Firm and Wage Maximizing Delegates of the Union

We consider the case in which the objective of the union's delegates is to maximize the wage rate, while the firm tries to maximize its own surplus. When only the wage rate is negotiated, the firm selects employment level to maximize the firm's surplus for an agreed upon wage rate. The bargaining frontier is attained by setting the employment level at $q^*(w)$ for any w. Therefore, the bargaining frontiers are the same, whether or not the employment level is included in the negotiation. This implies that negotiation results are the same between the two cases, so that we can assume without loss of generality that the firm and union delegates negotiate over only the wage rate.

Since the slope of the bargaining frontier equals $-q^*(w)$ for any w and $q^*(w)$ is decreasing in w, the bargaining frontier is convex to the origin as depicted in figure 2. As Herrero (1989) shows, the Nash bargaining solution as a limit of the subgame perfect equilibrium in the Rubinstein bargaining model can still be characterized by the tangency between the bargaining frontier and a level curve of the Nash product. In figure 2, the Nash bargaining solution is shown by N. Let $\tilde{w}$ denote the negotiated wage rate and $\tilde{S}_F = S_F(\tilde{w}, q^*(\tilde{w}))$ and $\tilde{S}_U = S_U(\tilde{w}, q^*(\tilde{w}))$ the resulting surpluses for the firm and union, respectively. At N, the slope of the bargaining frontier, $-q^*(\tilde{w})$, equals the slope of the level curve of the Nash product, $-\tilde{S}_F/\tilde{w}$. Then it follows from $\tilde{S}_U = \tilde{w}q^*(\tilde{w})$ that $\tilde{S}_F = \tilde{S}_U$.

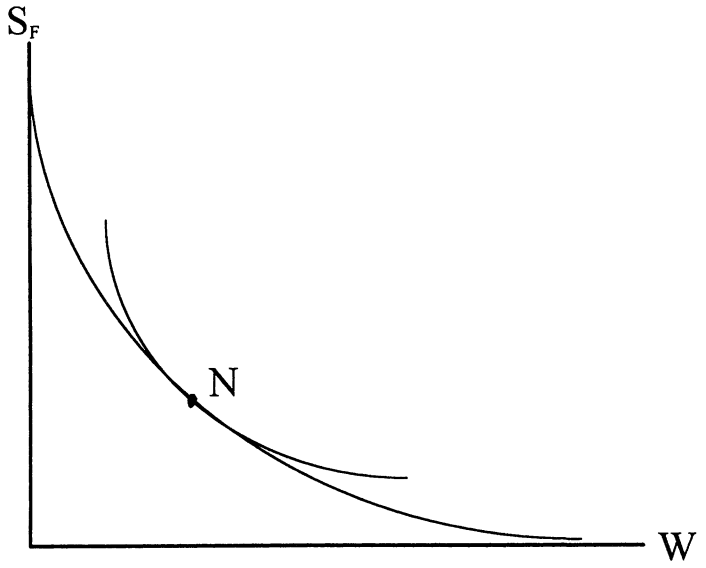

FIG. 2.—Nash bargaining solution with wage-maximizing union delegates

The payoff profile (for the union and firm) at the solution is shown by $\tilde{S}$ in figure 1.

PROPOSITION 3.—Provided that the objective of the union's delegates is to maximize the wage rate, the Nash bargaining solution yields $(\tilde{w}, q^*(\tilde{w}))$, such that $\tilde{S}_U = \tilde{S}_F$.

V. The Union's Choice for Delegates

Whether the union chooses surplus-maximizing or wage-maximizing delegates depends on which of the three stationary outcomes in proposition 2 is expected. As seen from figure 1, the union will choose surplus-maximizing delegates if outcome i is expected to arise. However, if outcome ii or iii is expected, the union may be better off by choosing wage-maximizing delegates. This is indeed the case if the feasible set, when only the wage rate is negotiated, is convex, and its payoff frontier is downward-sloping at $\tilde{S}$, as figure 1 depicts.

In contrast, the firm is certainly worse off if the union sends wage-maximizing delegates to the negotiation. As for the joint surplus, the agreement represented by S^{**} yields the highest joint surplus, followed by S^* and $\tilde{S}$ in this order, since the firm's revenue is maximized in the agreement S^{**} and its output is smaller at S^* and is even more so at $\tilde{S}$.

PROPOSITION 4.—The union chooses surplus-maximizing delegates if outcome i of proposition 2 is expected to arise in equilibrium. However,

it chooses wage-maximizing delegates if outcome ii or iii is expected and both $R'''(q) \leq R''(q)^2/R'(q)$ and $P'(q) + P''(q)q \leq 0$ are satisfied. Regardless of equilibrium selection in proposition 2, the firm is worse off if the union chooses wage-maximizing delegates.

The first condition $R'''(q) \leq R''(q)^2/R'(q)$ is a sufficient condition for the convexity of the feasible set, which also appears in proposition 1. The second condition $P'(q) + P''(q)q \leq 0$ implies that the payoff frontier is downward sloping at $\tilde{S}$, and is satisfied if $P''(q) \leq 0$. Although $R'''(q) = 3P''(q) + P'''(q)q$ involves the third derivative of $P(q)$, the first condition is more likely to be satisfied as well if $P''(q) \leq 0$.[7]

VI. Evidence from Union Contract Negotiations

This section addresses the model's applicability to union contract negotiations. In particular, we consider whether evidence from union contract negotiations supports the inefficiency implications of the model's equilibria. Our model suggests that equilibrium outcomes that do not maximize total surplus may occur for two reasons. First, inefficiency may result from excluding items (such as employment level) from the bargaining agenda. Second, delay to agreement due to negotiating over the items in the bargaining agenda may be the source of the inefficiency.

The model's equilibrium outcomes where employment level is not included in the bargaining agenda do not maximize total surplus and are thus inefficient. Walton and McKersie (1965) discuss how an inefficient outcome may occur due to restricting the items on the bargaining agenda. Walton and McKersie note that by assigning subcommittees to an issue on the bargaining agenda, a bargainer may convey a lack of commitment on the issue that could hurt when negotiating over how the surplus is to be divided. In this manner, items could be left off of the agenda even though including those items increases total surplus.[8] Finally, Walton and McKersie identify two primary reasons why negotiators do not first maximize joint surplus and then divide the surplus through aggressive bargaining. First, they stress that how the surplus is divided often cannot be kept separate from the search for additional joint surplus. While this

[7] Note 5 considers $P(q) = a - bq^c$ ($a > 0$, $b > 0$, and $c \geq 1$). In this case, we found that $R'''(q) \leq 0$. Moreover, it is apparent that $P''(q) = -bc(c-1)q^{c-2} \leq 0$. Consequently, we have a situation as depicted in figure 1, if the inverse demand function is characterized in such a way.

[8] Another manner by which a bargainer can effectively exclude a topic in the bargaining process is by not addressing that item in the agreement proposals. In the January 19, 1993, issue of the *Daily Labor Report,* published by the Bureau of National Affairs, Robert Wages, president of the Oil, Chemical, and Atomic Workers Union, describes Amoco's proposal as unacceptable for failing to adequately address economic issues or other items included in the union's demands.

can theoretically be overcome by side payments, Walton and McKersie state that a mechanism for side payments is often not available. Because "collective bargaining is orientated to discrete subjects and solutions," it is difficult for a negotiator who has been disadvantaged in one area to establish a claim to more of the surplus in another area. Second, Walton and McKersie emphasize that a negotiator cannot be certain that under the guise of increasing the joint surplus his opponent is not merely introducing subjects whose "solutions" result in obtaining a disproportionate share of the surplus. These two reasons could cause the agreement between the parties to not maximize joint surplus and thus be inefficient.

Although delay to agreement is often attributed to incomplete information, our model suggests that delay can occur as a result of conflicting interests of the firm and union over the bargaining agenda. The model's equilibria predict that delay may occur because the union prefers employment level or job security to be included in the bargaining agenda, while the firm prefers that it is not included. A review of *Contemporary Collective Bargaining: In the Private Sector* (Voos 1994) and the *Daily Labor Reports* (Bureau of National Affairs 1995–98) indicates that the main issue in many strikes is job security.[9] These publications report job security being the important issue in the 1955 USWA contract negotiations with nine major steel producers, the 1986 USWA strike of USX, the 1992 International Association of Machinists and Aerospace Workers (IAM) negotiations with Boeing, the Hotel Employees and Restaurant Employees Union 1994 strike of 17 San Francisco hotels, the Amalgamated Clothing and Textile Workers Union's 1994 strike of VF Corporation, the Teamster's 1995 strike of Ryder System Incorporated, the International Longshoremen's and Warehousemen's Union's 1995 strike of Yusen Terminals Incorporated, the 1996 IAM strike of Boeing, the 1996 IAM strike of McDonnell Douglas, the Air Line Pilots Association's 1997 strike of Air Canada, the Teamster's 1998 strike of United Postal Service, and the 1996–98 United Autoworkers (UAW) strikes of the Big Three automakers (General Motors [GM], Ford, and Chrysler).[10] Based on the limited descriptions in *Contemporary Collective Bargaining in the Private Sector* and the *Daily Labor Reports,* it is difficult to determine whether the delay in some of these negotiations was caused by negotia-

[9] The evidence provided was obtained from these two sources.

[10] "Yokich (United Auto Workers' President) sounded a constant theme, repeatedly calling job security the union's top priority. . . . when Yokich resumed his talks, GM wouldn't agree to the 95% guarantees, even with the loopholes. Frustrated, Yokich in late October orchestrated two locals to call strikes at high-profit plants. . . . The union, which initially sought employment guarantees, agreed to a contract that keeps the number of UAW members employed by GM, Ford and Chrysler at 95% of current levels" (*Business Week,* November 18, 1996).

tions over the level of job security or negotiations over the inclusion of job security in the bargaining agenda. However, in several of these negotiations there is evidence that the delay resulted from the difficulty in agreeing to the bargaining agenda. This evidence consists of (1) specific reference to delay in reaching agreement caused by negotiating over whether job security issues are included in the bargaining agenda, and (2) agreements where job security issues are not addressed, although it was identified during negotiations as an issue of importance to the union.[11]

The 1955 USWA contract negotiations with the steel producers provide evidence of delay resulting from negotiating over the bargaining agenda, as the firms' representatives initially refused to negotiate on supplemental unemployment benefits. Additional evidence is provided by USWA's 1986 negotiations with USX that resulted in a 6-month lockout. USWA attempted to achieve similar employment security provisions as those in the 1986 agreement with National Steel. However, the contractual agreement reached with USX that ended the lockout did not address employment security provisions. In the 1992 negotiations with Boeing, the IAM stated that their main concern was to limit subcontracting. This issue was not addressed in the final agreement with Boeing. However, in the fall of 1996, after Boeing machinists went on strike, the IAM reached an agreement that, while not providing job guarantees, did provide some basic job security protections such as advance notification of subcontracting, severance pay, and retraining. As the following excerpt from the August 21, 1996, *Daily Labor Report* indicates, negotiations over whether job security was included in bargaining agenda contributed to the IAM's strike against McDonnell Douglas.

> Talks between McDonnell Douglas Corp. and the International Association of Machinists broke off last week when union negotiators left the table saying there is no reason to meet again until the company is ready to talk about job security, a company official said. No talks were scheduled as of Aug. 19, the 76th day of the strike. . . . Williams (McDonnell Douglas vice president of commu-

[11] Our model abstracts from the many issues dealt with in union contract negotiations and considers perhaps the two primary concerns: compensation and job security. Compensation and job security are often functions of many of the issues negotiated. For example, union members' total compensation is a function of the agreed upon wage, overtime, pension benefits, and health benefits. Other issues, such as job scope, firm's hiring practices, firm's investment decisions, union security, supplemental unemployment benefits (SUB), Guaranteed Income Stream (GIS), and outsourcing affect union members' job security. Several of these, like the SUB and GIS, increase job security by increasing the firm's cost of laying off union workers. For simplicity, compensation in our model is strictly a function of the agreed upon wage, and job security is strictly a function of the agreed upon employment level.

> nications) said, "The union is adamant about getting job guarantees for 6,700 machinists, and we are just as adamant that we're not going to do it." He added that, "It would simply be an imprudent business decision. They have to understand that McDonnell Douglas runs this business, not the union." . . . "The company has effectively sabotaged the talks," Gerald Oulson, president of International Association of Machinist-District 837, said in an Aug. 15 statement. "The union made new proposals last week to accommodate this company's needs for job flexibility with the clear expectation that the company would accommodate the workers' main concerns on job security. But today the company claimed their negotiators have no authority to discuss job security and the subject is no longer even on the table." Oulson said, "There will be no agreement without job security."

After over 4 months on strike, the IAM obtained from McDonnell Douglas similar job security protections as from Boeing.

VII. Conclusion

The recent literature on union contract negotiations often attributes inefficient outcomes to incomplete information that causes delay to agreement. This article introduces two other possible sources of inefficiency. We argue that inefficiency can arise due to restricting and negotiating over the items contained in the bargaining agenda. Negotiating over the bargaining agenda may result in delay to agreement. In addition, this article provides an explanation of why senior union members (i.e., wage-maximizing individuals) may represent the union in contract negotiations. 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.

Although our analysis proceeds with a firm-union labor contract negotiation, it can be applied to any negotiation in which double marginalization may occur. The concept of double marginalization is usually discussed in the context of an upstream firm that sells a good to a downstream firm where both firms have market power. Milgrom and Roberts (1992) define double marginalization as "the tendency of two firms, one which supplies the other, to set prices at such a high level as each adds a profit margin to its own marginal cost that their combined profits would be increased if the final price were lowered" (p. 598). Double marginalization occurs when the vertically related firms agree on a per unit price greater than the upstream firm's marginal cost. Possible responses to the issue of double marginalization include vertical integration of the firms (Spengler 1950), a two-part tariff with the per unit price set equal to the upstream firm's marginal cost and resale price maintenance (see Tirole 1989 for details). Our model considers negotiations over

both price (wage) and quantity (employment level). However, any price (p) and quantity (q) agreement can be replicated by a two-part tariff where the per unit price is set so that the downstream firm purchases quantity q and the fixed fee is selected so that the downstream firm's total payment is p times q.[12]

Appendix

Proof of lemma 1.—Let $S_F^w(w) = S_F(w, q^*(w))$ and $S_U^w(w) = S_U(w, q^*(w))$. The slope of the payoff frontier is given by

$$\frac{S_F^{w'}(w)}{S_U^{w'}(w)} = -\frac{q^*(w)}{wq^{*\prime}(w) + q^*(w)}, \tag{A1}$$

since $S_F^{w'}(w) = -q^*(w)$, by the envelope theorem, and $S_U^{w'}(w) = wq^{*\prime}(w) + q^*(w)$ (see fig. 1). The second order condition for the firm's profit maximization is satisfied if $R''(q) < 0$. The level curve of the Nash product $S_F^w(w)S_U^w(w)$ has the slope $-S_F^w(w)/S_U^w(w)$ from the implicit function theorem. Because the slopes of the payoff frontier and level curve are equal at $(S_U^w(w^*), S_F^w(w^*))$,

$$\frac{S_F^w(w^*)}{S_U^w(w^*)} = -\frac{q^*(w^*)}{w^*q^{*\prime}(w^*) + q^*(w^*)}.$$

Therefore, $S_F^w(w^*) > S_U^w(w^*)$ if $q^{*\prime}(w^*) < 0$. Based on the assumption that $R''(q) < 0$, it follows from $q^{*\prime}(w) = 1/R''(q^*(w))$ for a surplus maximizing firm that $q^{*\prime}(w^*)$ is less than zero.

Proof of lemma 2.—Recall that $S_F(w, q) = R(q) - wq$ and $S_U(w, q) = wq$. The payoffs on the bargaining frontier occur at employment level q^{**} that satisfies $R'(q^{**}) = 0$ because total surplus is maximized at this employment level. The slope of the payoff frontier is

$$\frac{D_1S_F(w, q^{**})}{D_1S_U(w, q^{**})} = -1$$

for any w since $D_1S_F(w, q^{**}) = -q^{**}$ and $D_1S_U(w, q^{**}) = q^{**}$. The level curve of the Nash product $S_F(w, q)S_U(w, q)$ has the slope $-S_F(w, q)/S_U(w, q)$ from the implicit function theorem. Therefore, $S_F(w^{**}, q^{**}) = S_U(w^{**}, q^{**})$ at the Nash bargaining solution because the slopes of the payoff frontier and level curve are equal.

[12] In labor negotiations, the two-part tariff is analogous to a contract that results in quantity discounts on labor and a hiring rule that implements the discounts.

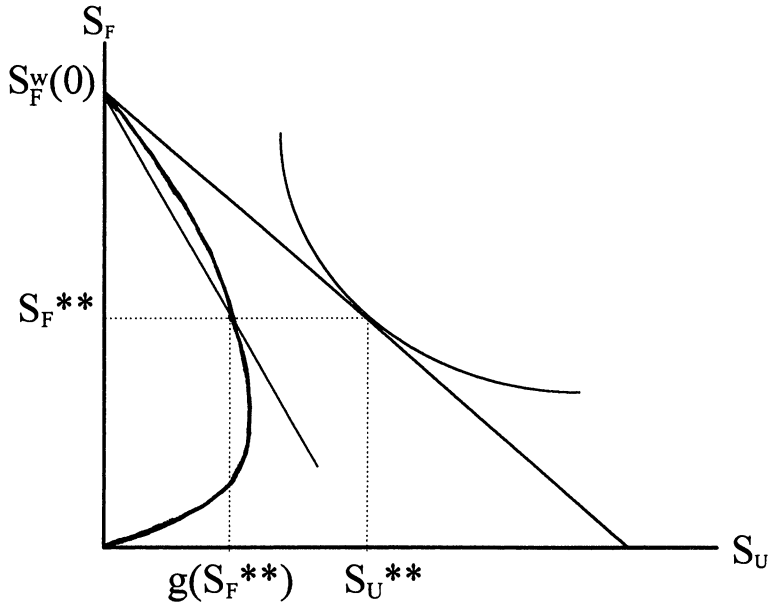

FIG. A1.—Convexity of the feasible set and the Nash bargaining solutions

Proof of proposition 1.—(i) The employment level, when both w and q are negotiated, satisfies $R'(q^{**}) = 0$. The employment level, when only w is negotiated, satisfies $R'(q^{*}) = w^{*}$. Based on the assumption that $R''(q) < 0$ and the fact that $w^{*} > 0$, the employment level and total surplus must be larger when both w and q are negotiated compared to when only the wage rate is negotiated. Thus, $S_F^{**} + S_U^{**} > S_F^{*} + S_U^{*}$. Lemmas 1 and 2 state that $S_F^{*} > S_U^{*}$ and $S_F^{**} = S_U^{**}$. Therefore, $S_U^{*} < S_U^{**}$. (ii) The graph in figure A1 depicts the bargaining frontiers when only w is negotiated and when w and q are negotiated. Let us define the function g such that $(g(s_F), s_F)$, where s_F denotes the firm's surplus, represents a point on the payoff frontier when only w is negotiated. It is easy to see that at $s_F = S_F^w(w)$, where S_F^w is defined in the proof of lemma 1, $g'(S_F^w(w))$ equals the reciprocal of (A1) derived in the proof of lemma 1, that is,

$$g'(S_F^w(w)) = -1 - \frac{wq^{*\prime}(w)}{q^{*}(w)}. \tag{A2}$$

To see which of S_F^{*} and S_F^{**} is greater, we examine the point $(g(S_F(w^{**}, q^{**})), S_F(w^{**}, q^{**}))$, or equivalently $(g(S_F^{**}), S_F^{**})$, on the payoff frontier when only w is negotiated. The slope of the Nash product at this point is given by $-S_F^{**}/g(S_F^{**})$. Then, it follows from $S_F^w(0) = 2S_F^{**}$ (lemma 2) that the tangent to the level curve of the Nash product (not shown) at this

point passes through the point $(0, S_F^w(0))$. Obviously, which of S_F^* and S_F^{**} is greater depends on the shape of the payoff frontier. In fact, $S_F^* > S_F^{**}$ if the payoff frontier cuts the tangent from above at $(g(S_F^{**}), S_F^{**})$ as shown in figure A1, and $S_F^* < S_F^{**}$ if the payoff frontier cuts the tangent from below. Since the slope of the payoff frontier when only w is negotiated equals -1 at $(0, S_F^w(0))$ as seen from (A1), it follows immediately that $S_F^* > S_F^{**}$ if the function g is concave. By differentiating with respect to w and substituting $S_F^w(w) = -q^*(w)$, we have

$$g''(S_F^w(w)) = \frac{[q^{*\prime}(w) + wq^{*\prime\prime}(w)]q^*(w) - wq^{*\prime}(w)^2}{q^*(w)^3}.$$

Since $w > 0$ and $q^{*\prime}(w) < 0$, we find that $g''(S_F^w(w)) < 0$ if $q^{*\prime\prime}(w) \leq 0$. Now, we have derived in the proof of proposition 1 that $q^{*\prime}(w) = 1/R''(q^*(w))$. Consequently, we have

$$q^{*\prime\prime}(w) = -\frac{R'''(q^*(w))q^{*\prime}(w)}{R''(q^*(w))^2}.$$

Thus we find that $q^{*\prime\prime}(w) \leq 0$ and hence $S_F^* > S_F^{**}$ if $R'''(q^*(w)) \leq 0$.

Proof of proposition 2.—Since $S_U^{**} > S_U^*$ (proposition 1), it is obvious that if $S_F^{**} \geq S_F^*$ both the firm and union immediately agree to negotiate over both wage rate and employment level. It is also easy to see that if $S_F^{**} < S_F^*$ the conflict can immediately be solved as described in (i) or (ii) or proposition 2. Therefore, what remains to be shown is that the strategy profile described in (iii) is subgame perfect when $S_F^{**} < S_F^*$. In the mixed strategy equilibrium, both the firm and union should be indifferent between conceding now and waiting a little longer to see if the opponent will concede. Let h_F and h_U denote the firm's and union's hazard rates of conceding, respectively. Then for a small $\varepsilon > 0$, the firm's expected payoff is S_F^{**} if it concedes immediately at time t and is $h_U\varepsilon S_F^* + (1 - h_U\varepsilon)e^{-r\varepsilon}S_F^{**}$ if it concedes at $t + \varepsilon$, while the union's expected payoff is S_U^* if it concedes at t and is $h_F\varepsilon S_U^{**} + (1 - h_F\varepsilon)e^{-r\varepsilon}S_U^*$ if it concedes at $t + \varepsilon$. Therefore, for the firm to be indifferent between conceding at t and conceding at $t + \varepsilon$, it must be the case that

$$S_F^{**} = h_U\varepsilon S_F^* + (1 - h_U\varepsilon)e^{-r\varepsilon}S_F^{**}$$

$$h_U(S_F^* - e^{-r\varepsilon}S_F^{**}) = \frac{1 - e^{-r\varepsilon}}{\varepsilon}S_F^{**}.$$

Since $e^{-r\varepsilon} \to 1$ and

$$\frac{1 - e^{-r\varepsilon}}{\varepsilon} \to r$$

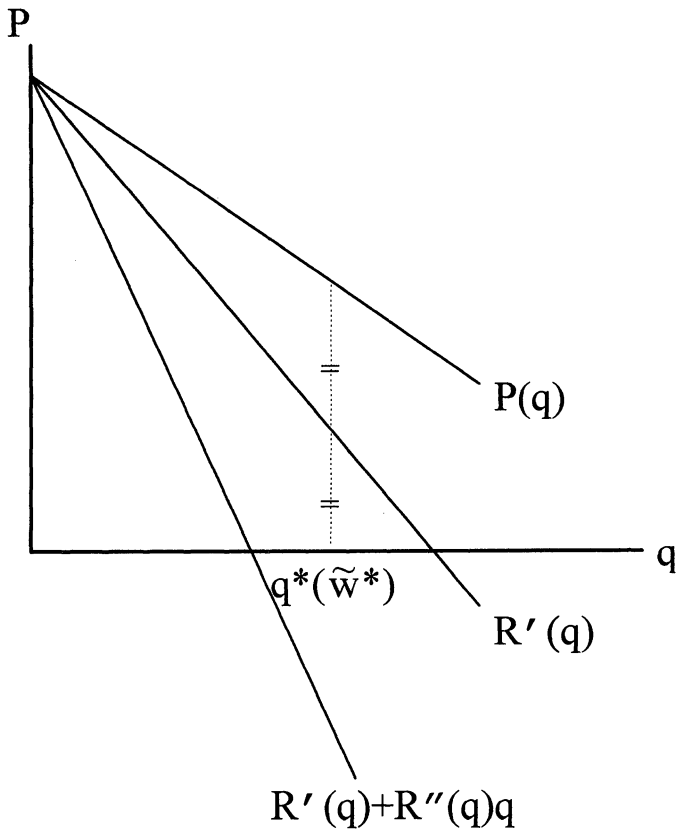

FIG. A2.—A sufficient condition in proposition 4

as $\varepsilon \to 0$, we have

$$h_U = \frac{rS_F^{**}}{S_F^{*} - S_F^{**}}$$

in the limit, as desired. Similarly, we obtain

$$h_F = \frac{rS_U^{*}}{S_U^{**} - S_U^{*}}$$

as $\varepsilon \to 0$.

Proof of proposition 3.—First, we show that the bargaining frontier is convex to the origin, as shown in figure 2. For a given w, $q^*(w)$ maximizes the firm's surplus so that the height of the bargaining frontier

is given by $S_F^w(w) = R(q^*(w)) - wq^*(w)$. The slope of the bargaining frontier is $S_F^{w'}(w) = -q^*(w)$ from the envelope theorem. Then, it follows from $S_F^{w''}(w) = -q^{*\prime}(w) = -1/R''(q^*(w)) > 0$ that the bargaining frontier is convex to the origin.

At the Nash bargaining solution, $(\tilde{w}, \tilde{S}_F)$, the slope of the bargaining frontier, $-q^*(w)$, must be equal to the slope of the Nash product, $-\tilde{S}_F/\tilde{w}$, which yields $\tilde{S}_F = \tilde{S}_U$ for $\tilde{S}_U = \tilde{w}q^*(\tilde{w})$.

Proof of proposition 4.—First, we show that $S_F^* > \tilde{S}_F$. Since an increase in w lowers the firm's surplus, one moves down the payoff frontier, when only w is negotiated, monotonically as w increases. Lemma 1 and proposition 3 imply that $w^* < \tilde{w}$, which in turn implies $S_F^* > \tilde{S}_F$.

Next, we find a sufficient condition for $S_U^* < \tilde{S}_U$. It is evident from figure 1 that $S_U^* < \tilde{S}_U$ if the feasible set is convex and the payoff frontier is downward sloping at $\tilde{S}$. In proposition 1, we show that the feasible set is convex if $R'''(q) \leq R''(q)^2/R'(q)$. Thus, what remains to be shown is that the payoff frontier is downward sloping at $\tilde{S}$ if $P'(q) + P''(q)q \leq 0$. It follows from $\tilde{S}_F = \tilde{S}_U$ that $P(q^*(\tilde{w})) - \tilde{w} = \tilde{w}$. By the firm's profit maximization, it means that $2R'(q^*(\tilde{w})) = P(q^*(\tilde{w}))$, as figure A2 shows. Notice that this condition can be rewritten as $P(q^*(\tilde{w})) + 2P'(q^*(\tilde{w}))q^*(\tilde{w}) = 0$ since $R'(q) = P(q) + P'(q)q$. Now, since the union's surplus can be written as $R'(q)q$, the marginal surplus equals $R'(q) + R''(q)q = P(q) + 3P'(q)q + P''(q)q^2$. Since $q^{*\prime}(w) < 0$, the bargaining frontier is downward sloping at $\tilde{S}$ if and only if $P(q) + 3P'(q)q + P''(q)q^2 \leq 0$ at $q = q^*(\tilde{w})$. Using $P(q) + 2P'(q)q = 0$ at $q = q^*(\tilde{w})$, this inequality can be reduced to $P'(q^*(\tilde{w})) + P''(q^*(\tilde{w}))q^*(\tilde{w}) \leq 0$, which is satisfied if $P'(q) + P''(q)q \leq 0$ for any $q > 0$.

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