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Journal of Labor Economics, Vol. 6, No. 3. (Jul., 1988), pp. 397-422.

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Multiunit Bargaining in Oligopolistic Industries

Carl Davidson, *Michigan State University*

A model of wage determination in unionized oligopolistic industries is developed and used to compare the outcome of collective bargaining under two different bargaining structures—one in which the workers of each firm are represented by separate and independent unions (local bargaining) and one in which a national union represents all workers in the industry. In both cases, the bargaining problem has a unique outcome with industrywide bargaining resulting in higher wages. In addition, industrywide unions are inherently stable in that there are no incentives for independent unions to attempt to cheat on the collusive agreement.

I. Introduction

The status of contract negotiations between the United Auto Workers and the major domestic auto producers is considered important national news. In fact, the result of contract talks between any major union and its employer is considered important since such results often set the pattern for bargaining in related industries. Because of this, a great deal of effort has been devoted to modeling and analyzing the process of collective bargaining (see Farber [1984] for a recent survey of the literature). While it is clearly important to understand this process, it is also important to understand how institutional features such as bargaining structure affect the outcome of these negotiations. The purpose of this article is to provide

I wish to thank Mordechai Kreinin for sparking my interest in this topic and Daniel Hamermesh and Harry Holzer for directing me to much of the relevant literature. I also benefited from discussions with Ken Boyer, Raymond Deneckere, Charles Larrowe, Donald Parsons, Paul Segerstrom, and John Wolfe. Their comments have greatly improved this article, and I am happy that I have this opportunity to thank them.

[*Journal of Labor Economics*, 1988, vol. 6, no. 3]
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0734-306X/88/0603-0006\$01.50

some preliminary answers to this second question. That is, the purpose of this article is to investigate the relation between bargaining structure and wages in unionized industries. To do so, a model of wage determination in unionized oligopolistic industries is developed. The model is then used to compare the outcome of collective bargaining under two different bargaining structures—one in which the workers of each firm are represented by separate and independent unions (local bargaining) and one in which a national union represents all the workers in the industry.

There are three reasons for this study. To begin with, although multiunit bargaining is the predominant form of collective bargaining in this country, this is the first theoretical investigation of its consequences.¹ Second, although there is an extensive empirical literature linking market concentration to industry wages, to my knowledge no theoretical analysis of wage determination in unionized oligopolistic industries exists.² That is, in spite of the fact that many major unionized industries are oligopolistic (e.g., automobiles, steel, tires), all previous theoretical studies of the effect of unionization on wage rates assume that the product market is either monopolistic or competitive, thereby abstracting from some interesting interactions between firms and unions that should affect the outcome of collective bargaining.

The reason so little attention has been paid to multiunit bargaining and wage determination in oligopolistic markets is simple. Until recently almost all formal approaches to bargaining have been axiomatic. Therefore, the solution to the bargaining problem has been, in some sense, ad hoc since the bargaining process is not explicitly modeled.³ Because of this, it is difficult (if not impossible) to know how to modify the analysis when the bargaining structure changes. However, recent advances in noncooperative game theory make it possible to model the bargaining process explicitly and, in this article, the solution to the bargaining problem is the outgrowth of a very natural bargaining process. This also allows for a direct comparison of wages across bargaining structures. Therefore, the third reason for writing this article is to show how recent advances in noncooperative game theory can be applied to investigate issues that could not be addressed easily in existing models.

¹ There is a small, primarily empirical, literature devoted to analyzing the effect of *multiemployer* bargaining (see Hendricks 1975; Hendricks and Kahn 1982, 1984). These articles do not investigate the effects of varying the degree of cooperation between the workers' bargaining units because of a lack of data on local unions in the United States. One unrelated article that focuses on the anticompetitive nature of certain bargaining structures is Williamson (1968).

² See, e.g., Weiss (1966), Allen (1968), and Rosen (1969).

³ See, e.g., Ashenfelter and Johnson (1969), DeMenil (1971), or McDonald and Solow (1981). Not all of the articles follow the axiomatic approach. However, the bargaining process is not modeled in any of them, so that my remarks apply.

In order to provide some insight into the nature of collective bargaining in oligopolistic industries and the impact of different bargaining structures, consider a market consisting of two identical unionized firms. Assume that each firm bargains over wages with the union representing its workers and that, once the wage is set, the firm chooses output and employment to maximize profits.⁴ Assume further that each union attempts to maximize a utility function that is increasing in the employment and wages of its members. Consider first the bargaining problem faced by firm 1 and the union representing its workers. For any given w_2 (the wage paid by firm 2) there will be a Pareto frontier (or efficiency locus) representing the maximum profit firm 1 can earn for any given level of utility achieved by the union. The goal of negotiations between the firm and union is to pick out one point on this Pareto frontier (and hence, one wage). Higher values of w_2 enhance firm 1's competitive position in the product market (regardless of the value of w_1) and, thus, cause the Pareto frontier to shift out. Therefore, the two Pareto frontiers that define the range of possible outcomes of the bargaining processes are interdependent. If the workers at firm 1 manage to secure a higher wage for themselves, a positive externality is created in that the size of the pie to be divided by firm 2 and its workers is increased. When the unions bargain independently they ignore this externality and settle for too low a wage. If the unions merge and form an industrywide union, this externality is internalized, leading to higher wages, lower profits for the firms, and higher prices for consumers. Note that this externality is not present in competitive markets since an increase in the wage paid by any given firm has a negligible effect on all other firms.

In addition to the externality effect, there is another, perhaps more obvious, reason that wages rise in the presence of industrywide bargaining: the cost of striking one firm is lower for a national union than a local union. A local union is only concerned with the wages and employment of its own workers, and thus, when a local union strikes against a firm, its utility falls to zero as long as the strike lasts. However, a national union takes into account the wages and employment of all workers in the industry. If the union strikes against firm 1 firm 2 becomes more powerful (during the strike) and increases employment, partially offsetting the union's loss in utility. Thus, a national union's threat of a strike is more credible (in the sense that its cost is lower), which allows it to secure a higher wage for its workers.

Before turning to the formal analysis, a few words about the approach taken in this article are in order. Throughout this article the assumption

⁴ In most collective bargaining agreements, the choice of employment is left to the firm (see Rees 1977, p. 127; and Oswald 1984). For a theoretical justification of this assumption see Oswald (1984).

that the firms and unions possess complete information is maintained. This assumption, along with the assumption that the firms and unions are rational, rules out the possibility of strikes in equilibrium (although the threat of a strike does play a crucial role in determining the outcome of collective bargaining). The effects of industrywide bargaining on strike frequency and duration are clearly important in assessing the welfare properties of different bargaining structures. However, before analyzing a model of collective bargaining under incomplete information, it is first necessary to completely understand the forces at work when information is complete.⁵

The remainder of this article is organized as follows. In Section II equilibrium in the product market is described for any doubleton (w_1, w_2) . I derive profits and employment at each firm as a function of the wage vector, and this allows me to describe the Pareto frontier over which the union and firm bargain. An attempt was made to keep this section as short as possible since the results (and the techniques used to derive them) are well known. The bargaining process is described in the first half of Section III, and then, in the second half of the section, I show how recent results from noncooperative bargaining theory can be applied in my framework. Sections IV and V are devoted to analyzing the bargaining problem under the two different bargaining structures. I show that in both cases there is a unique equilibrium wage vector that is proposed and accepted immediately. In addition, in Section V the equilibrium wage and profit levels under the two bargaining structures are compared. This article concludes with a brief Section VI, in which the results are summarized and discussed.

II. Equilibrium in the Product Market

In this section, equilibrium in the product market is described assuming that the wage rates have already been determined. Particular attention is paid to the properties of the equilibrium profit and employment functions since they play a crucial role in determining the outcome of collective bargaining.

Consider a market shielded from entry in which two firms produce a homogeneous product. Assume, for simplicity, that there is only one input, labor, and that each worker can produce one unit of output. Let w_i and ℓ_i denote the wage rate and employment level at firm i , and let $D(\ell_1 + \ell_2)$ denote the inverse demand function for the product. $D(\cdot)$ is assumed to be twice differentiable with $D'(\cdot) < 0$. Profits for firm i are given by

$$\pi_i(\ell_i, \ell_j, w_i, w_j) = [D(\ell_i + \ell_j) - w_i]\ell_i, \quad j \neq i. \quad (1)$$

⁵ For a discussion of the relationship between bargaining structure and strike activity, refer to Davidson and Cheung (1987).

Suppose that the wage rates have already been determined (through collective bargaining) and that the firms compete by choosing employment (and hence, output) to maximize profits with price automatically adjusting to clear the market (the standard Cournot-Nash assumption). Then a Nash equilibrium in this product market is achieved when each firm chooses its profit-maximizing level of employment based on correct expectations about employment by its rival. Formally,

DEFINITION 1. Values $[\ell_1^*(w_1, w_2), \ell_2^*(w_2, w_1)]$ constitute a Nash equilibrium in employment and output for wage rates (w_1, w_2) if

$$\pi_i[\ell_i^*(w_i, w_j), \ell_j^*(w_j, w_i), w_i, w_j] \geq \pi_i[\ell_i, \ell_j^*(w_j, w_i), w_i, w_j] \quad \forall \ell_i, \quad \text{for } i = 1, 2.$$

The first-order condition for firm i is obtained by differentiating equation (1) with respect to ℓ_i . I obtain

$$D'(\ell_1 + \ell_2)\ell_i + D(\ell_1 + \ell_2) - w_i = 0. \tag{2}$$

Equation (2) is an implicit function that defines the profit-maximizing level of ℓ_i for any given ℓ_j . Solving (2) for ℓ_i gives us firm i 's reaction function which is denoted by $\ell_i^*(\ell_j)$. Define $\ell_j^*(\ell_i)$ in an analogous manner. The intersection of the two reaction functions yields the equilibrium levels of employment.

In order to insure existence, uniqueness, and stability of equilibrium, I assume that firm i 's marginal revenue, $[D'(\ell_1 + \ell_2)\ell_i + D(\ell_1 + \ell_2)]$, is a decreasing function of ℓ_j ,⁶

$$D''(\ell_1 + \ell_2)\ell_i + D'(\ell_1 + \ell_2) < 0 \quad \forall i, \tag{3}$$

and that firm 1's reaction function is steeper than firm 2's:⁷

$$\Delta \equiv D'(\ell_1 + \ell_2)[3D'(\ell_1 + \ell_2) + (\ell_1 + \ell_2)D''(\ell_1 + \ell_2)] > 0. \tag{4}$$

Standard comparative-statics techniques yield the following results:

$$\frac{\partial \ell_i(w_i, w_j)}{\partial w_i} = \frac{1}{\Delta} [2D'(\ell_1 + \ell_2) + \ell_j D''(\ell_1 + \ell_2)] < 0, \tag{5}$$

and

$$\frac{\partial \ell_i(w_i, w_j)}{\partial w_j} = -\frac{1}{\Delta} [D'(\ell_1 + \ell_2) + \ell_i D''(\ell_1 + \ell_2)] > 0. \tag{6}$$

⁶ See Friedman (1977), pp. 70-74, 168-72.

⁷ See *ibid.*, pp. 70-74.

An increase in the wage paid by firm i reduces firm i 's equilibrium level of employment and increases employment at firm j . Note that

$$\left| \frac{\partial \ell_i(w_i, w_j)}{\partial w_i} \right| > \frac{\partial \ell_j(w_i, w_j)}{\partial w_i},$$

so that total employment decreases when w_i rises.

Finally, substituting $\ell_1(w_1, w_2)$ and $\ell_2(w_2, w_1)$ into (1) yields equilibrium profit as a function of wages:

$$\pi_i(w_i, w_j) = \{D[\ell_1(w_1, w_2) + \ell_2(w_2, w_1)] - w_i\} \ell_i(w_i, w_j). \quad (7)$$

Differentiating (7) and substituting from (2), I have

$$\frac{\partial \pi_i(w_i, w_j)}{\partial w_i} = -[D(\ell_1 + \ell_2) - w_i] \frac{\partial \ell_j(w_i, w_j)}{\partial w_i} - \ell_i(w_i, w_j) < 0, \quad (8)$$

and

$$\frac{\partial \pi_i(w_i, w_j)}{\partial w_j} = -[D(\ell_1 + \ell_2) - w_i] \frac{\partial \ell_j}{\partial w_j} > 0. \quad (9)$$

Not surprisingly, firm i 's profits are decreasing in its own wage and increasing in w_j . After some calculations using the first-order conditions and equations (5) and (6), it is also possible to show that in symmetric equilibria (i.e., $w_1 = w_2$)

$$\text{sign} \left(\frac{\partial \pi_i}{\partial w_i} + \frac{\partial \pi_i}{\partial w_j} \right) = \text{sign}(D' + \ell_i D'') < 0, \quad (10)$$

so that the own effect dominates the cross effect. Thus, if the initial equilibrium is symmetric and both wages rise by the same amount, profits will fall.

III. Preliminaries

In this section, I describe the bargaining process and then demonstrate how recent results from the noncooperative bargaining literature can be used to predict the outcome of the negotiations in certain situations. These preliminary results form the basis for the solution to the bargaining problems discussed in Sections IV and V.

A. The Bargaining Process

Each firm and the union representing its workers negotiate in order to determine the wage rate, with employment set by the firm according to

the function $\ell_i(w_i, w_j)$, derived above. I assume that the negotiations occur simultaneously and take the following form: at time 0 each union proposes a wage rate that its firm may accept or reject. If a firm decides to reject the wage, it may make a counteroffer in the next period, which its union may accept or reject. This process of exchanging offers continues until an agreement is reached. To capture the notion that the time it takes to come to terms is small relative to the length of the contract, I assume that the time between periods is very small (to be made precise below) and that production occurs only when either both firms have come to terms with their workers or when one firm settles with its union and the other union decides to leave the bargaining table and strike.

In order to begin to analyze the bargaining problem, I must first describe (i) the goals of the union and firm, (ii) their payoffs if agreement is reached, (iii) their payoffs if no agreement is reached (i.e., their threat-point payoffs), and (iv) the feasible set over which they bargain. Consider first the case of independent bargaining. In this case, I assume that union i 's goal is to maximize a quasi-concave utility function, $U_i[w_i, \ell_i(w_i, w_j)]$, which is increasing in both arguments, while firm i 's goal is to maximize profit, $\pi_i(w_i, w_j)$, which is decreasing in w_i . Each utility function is assumed to be single peaked in w_i for any w_j , so that it has a unique maximizer, say, $\bar{w}_i(w_j)$. If, in period t , an agreement has been reached at both firms resulting in wages w_i and w_j , then union i 's payoff is $\delta^t U_i[w_i, \ell_i(w_i, w_j)]$, and firm i earns $\delta^t \pi_i(w_i, w_j)$ where $\delta \in (0, 1)$ denotes the common discount factor. If no agreement is reached at firm i , then the firm earns no profit, and the union's utility is $U_i(0, 0)$, which is normalized to be zero. The notion that the time between offers is small is captured by calculating the equilibrium wages for any $\delta \in (0, 1)$ and then taking the limit as δ goes to one.

In the case of industrywide bargaining, the union is assumed to maximize the sum of utilities (this assumption simplifies the analysis but is not essential for our results).⁸ Therefore, if neither firm settles with the union, the union's payoff is zero. If, however, firm i agrees to pay w_i , and firm j fails to settle, the union earns $U_i[w_i, \ell_i^m(w_i)]$, where $\ell_i^m(w_i)$ denotes the number of workers employed by a monopolist paying w_i . Note that a strike at firm j enhances the welfare of the workers at firm i by making firm i a monopolist in the product market and triggering an increase in employment.

The feasible set consists of all pairs (U_i, π_i) that are attainable. Because of space considerations, I do not provide a detailed description of this set (if interested, one can refer to the working paper version of this article, Davidson [1985]). However, it is important to note that the set is convex

⁸ As should be clear from the proofs, all results would go through if I assume that the industrywide union maximizes a welfare function $G(U_1, U_2)$ that is increasing in both arguments.

and that, along the Pareto frontier, $dU_i/dw_i > 0$. That is, any efficient contract will leave the union desiring a higher wage. The reasoning behind this result is simple. Since π_i is decreasing in w_i , the firm always prefers a lower wage. If the union also prefers a lower wage (i.e., if the employment effect outweighs the direct wage effect on utility), then both parties could be made better off by lowering w_i . Therefore, along the Pareto frontier, the union must prefer a higher wage. This fact will prove useful in analyzing the desirability of multiunit bargaining in Section V.

B. Equilibrium in the Subgames

We now have all the elements necessary to solve for the equilibrium wages. Although the general bargaining problem is quite complex (there are two simultaneous two-person bargaining problems with interdependent Pareto frontiers to be considered), it turns out that the equilibrium wages are completely determined by what happens in the subgames in which one firm and its union are still negotiating and the other wage has already been determined. So, consider the problem faced by firm i and its union if, at some point in the game, they have still not reached an agreement but w_j has already been proposed and accepted.

With w_j fixed we are left with a two-person bargaining problem regardless of the union's bargaining arrangement. There has been a considerable amount of work done recently analyzing two-person bargaining models with this structure. The result that is relevant for this article is that, in the model described above, for any $\delta \in (0, 1)$, there exists a unique perfect equilibrium outcome and, as $\delta \rightarrow 1$, the solution converges to the Nash cooperative-bargaining solution.⁹ In addition, the first offer is always accepted, so that an agreement is reached immediately. In the case of independent bargaining, this implies that if, at time t , w_i and w_j are proposed, w_i is accepted, and w_j rejected, then, at time $t + 1$, union i and its firm will agree on the wage that solves

$$\max_{w_i} U_i[w_i, \ell_i(w_i, w_j)]\pi_i(w_i, w_j). \quad (11)$$

⁹ See Binmore (1982) and McLennan (1982). In particular, theorem 5 of McLennan (p. 41) can be applied to obtain this result. As McLennan notes (bottom of p. 40), one need not assume that negotiations have an infinite horizon. One could assume, e.g., that negotiations take place during the interval $[0, 1]$. If at $t = 1$ one firm (i) has reached agreement with its union and the other (j) has not, then at $t = 1$ firm i begins production and firm j remains idle until the next period. It is worth noting that the Nash cooperative-bargaining solution has been used by DeMenil (1971) to model bargaining between a union and firm. However, DeMenil does not present a formal model of the bargaining process (his approach is axiomatic), and, thus, it is difficult to know how to generalize his model to the four-person bargaining problem considered here. It is worth noting that in his book DeMenil provides empirical support for Nash's bargaining solution.

Under the same circumstances, multiunit bargaining would lead to the wage that solves

$$\max_{w_i} \{ U_i[w_i, \ell_i(w_i, w_j)] + U_j[w_j, \ell_j(w_j, w_i)] - U_j[w_j, \ell_j^m(w_j)] \} \pi_i(w_i, w_j). \tag{12}$$

In either case, a strike at firm *i* would make firm *j* a monopolist in the product market. With independent bargaining this fact does not influence the outcome of the negotiations between firm *i* and its union. However, with multiunit bargaining, the increase in employment at firm *j* partially offsets the cost of the strike. This difference in threat points (and the difference in goals) implies that the wages solving (11) and (12) will be different.

Let $w_i^*(w_j)$ denote the solution to (11) and $w_i^j(w_j)$, the solution to (12). Differentiating (11) with respect to w_i yields the following first-order condition:

$$\left(\frac{\partial U_i}{\partial w_i} + \frac{\partial U_i}{\partial \ell_i} \frac{\partial \ell_i}{\partial w_i} \right) \pi_i + \frac{\partial \pi_i}{\partial w_i} U_i = 0. \tag{13}$$

The function $w_i^j(w_j)$ is obtained by solving (13). This equation can be simplified to (using the expressions derived in Sec. II)

$$\left(D' \frac{\partial \ell_i}{\partial w_i} - 1 \right) U_i + (D - w_i) \left(\frac{\partial U_i}{\partial w_i} + \frac{\partial U_i}{\partial \ell_i} \frac{\partial \ell_i}{\partial w_i} \right) = 0. \tag{14}$$

The function $w_i^*(w_j)$ and its analog $w_j^*(w_i)$ are depicted in figure 1.¹⁰ They are upward sloping since an increase in w_j enhances firm *i*'s competitive position in the product market, causing the firm to increase employment and raise its wage.¹¹

¹⁰ Value $w_i^*(w_j)$ should *not* be interpreted as a reaction function since it does not represent the best reply of one noncooperative player as a function of another player's strategy. Instead, $w_i^*(w_j)$ represents the outcome of the four-person non-cooperative game when a particular subgame is reached. In this subgame the strategies of union *j* and firm *j* are fixed since it is assumed that they have settled on a wage of w_j .

¹¹ Apply the implicit function theorem to (14) and use the second-order conditions to obtain

$$\text{sign} \frac{\partial w_i^*(w_j)}{\partial w_j} = \text{sign}(A + B + C + E),$$

with

$$A = \left[D'' \left(\frac{\partial \ell_i}{\partial w_j} + \frac{\partial \ell_i}{\partial w_i} \right) \frac{\partial \ell_i}{\partial w_i} + D' \frac{\partial^2 \ell_i}{\partial w_i \partial w_j} \right] U_i,$$

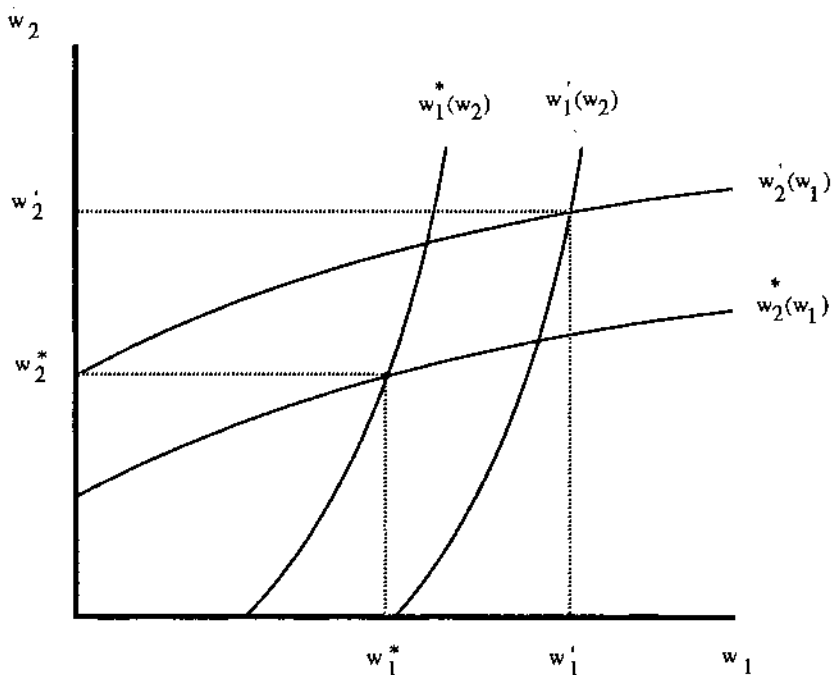


FIG. 1

$$B = D \left(\frac{\partial \ell_i}{\partial w_i} - 1 \right) \frac{\partial U_i}{\partial \ell_i} \frac{\partial \ell_i}{\partial w_j},$$

$$C = D \left(\frac{\partial \ell_i}{\partial w_j} + \frac{\partial \ell_i}{\partial w_i} \right) \frac{dU_i}{dw_i},$$

$$E = (D - w_i) \frac{\partial (dU_i)}{\partial w_i}.$$

Note that $B > 0$ and, since $|\partial \ell_i / \partial w_j| < |\partial \ell_i / \partial w_i|$, we also have $C > 0$. Turn next to A . Value $\partial^2 \ell_i / \partial w_i \partial w_j$ will, in general, be negative since higher values of w_j make firm i larger (since firm j becomes weaker), and thus an increase in w_i has a larger negative effect on ℓ_i when w_j is high. Thus, when demand is concave ($D'' < 0$) or not "too convex," we have $A > 0$. The sign of E is not obvious (although in most cases it is positive since an increase in w_j raises ℓ_i and makes wages relatively more important), but I assume that if it is negative it does not dominate $A + B + C$. Thus, if I assume that demand is either concave or not too convex, then $\partial w_i(w_j) / \partial w_j > 0$. Note that I have already assumed that demand is not strongly convex in (3) and (4), so that this assumption does not significantly weaken the analysis.

To find $w'_i(w_j)$, I differentiate (12) with respect to w_i to obtain

$$\left(\frac{\partial U_i}{\partial w_i} + \frac{\partial U_i}{\partial \ell_i} \frac{\partial \ell_i}{\partial w_i} + \frac{\partial U_j}{\partial \ell_j} \frac{\partial \ell_j}{\partial w_i} \right) \pi_i + \{U_i(w_i, \ell_i) + U_j(w_j, \ell_j) - U_j[w_j, \ell_j^m(w_j)]\} \frac{\partial \pi_i}{\partial w_i} = 0. \quad (15)$$

The function $w'_i(w_j)$ solves (15). To compare w_i^* and w'_i , I evaluate (15) at $w_i^*(w_j)$ and find that (using [13])

$$\frac{\partial U_j}{\partial \ell_j} \frac{\partial \ell_j}{\partial w_i} \pi_i + \left(U_j\{w_j, \ell_j[w_j, w_i^*(w_j)]\} - U_j[w_j, \ell_j^m(w_j)] \right) \frac{\partial \pi_i}{\partial w_i} > 0.$$

Thus, $w'_i(w_j) > w_i^*(w_j)$ for any w_j . This implies that in figure 1, $w'_i(w_j)$ lies to the right of $w_i^*(w_j)$, and $w'_j(w_i)$ lies above $w_j^*(w_i)$.

There are two reasons that a national union can extract a higher wage than an independent union. This can be seen by comparing (13) and (15). To begin with, the term $(\partial U_i / \partial \ell_i) (\partial \ell_i / \partial w_i)$ appears in equation (15) but does not appear in equation (13). This is due to the fact that when the unions bargain independently they ignore the positive externality created by an increase in wages. That is, if union i secures a higher wage from its firm, employment at firm j will rise, thereby increasing the utility of union j . This externality is internalized when the unions merge leading to a higher wage.

The second reason that wages rise is that the threat-point payoffs are higher for an industrywide union. An industrywide union that withdraws from negotiations with firm i recoups some of its losses when firm j increases employment. Since employment at firm j is of no concern to an *independent* union that bargains with firm i , its losses are greater when an agreement cannot be reached. The higher threat-point profits increase the bargaining power of the union and leads to higher wages.

In summary, the equilibrium wages in the subgames are represented by the curves in figure 1. In the next two sections, I demonstrate that the unique solutions to the two bargaining problems are given by the intersections of these curves.

IV. Collective Bargaining and Industrywide Unions

I begin with the case of industrywide bargaining since it is somewhat easier to analyze. To describe the bargaining problem, I define the following 3×1 payoff vectors:

$V(w_1, w_2) =$ the payoff vector when w_1 and w_2 are proposed and accepted in the same period;

- $V_i(w_j)$ = the payoff vector when firm i continues to bargain with the union after w_j is accepted;
 $V_m(w_i)$ = the payoff vector when w_i is accepted and the union withdraws from bargaining with firm j ;
 V_u = the equilibrium payoffs when the union gets to move first (i.e., the union makes the initial wage proposal); and
 V_F = the equilibrium payoffs when the firms get to move first.

Superscripts will be used to denote the elements of each vector with the first element representing the payoff to firm 1, the second, firm 2's payoff, and the last, the union's payoff. Thus, for example:

$$V(w_1, w_2) = \{\pi_1(w_1, w_2), \pi_2(w_2, w_1), U_1[w_1, \ell_1(w_1, w_2)] + U_2[w_2, \ell_2(w_2, w_1)]\},$$

$$V_1(w_2) = \left(\pi_1[w'_1(w_2), w_2], \pi_2[w_2, w'_1(w_2)], U_1\{w'_1(w_2), \ell_1[w'_1(w_2), w_2]\} + U_2\{w_2, \ell_2[w_2, w'_1(w_2)]\} \right),$$

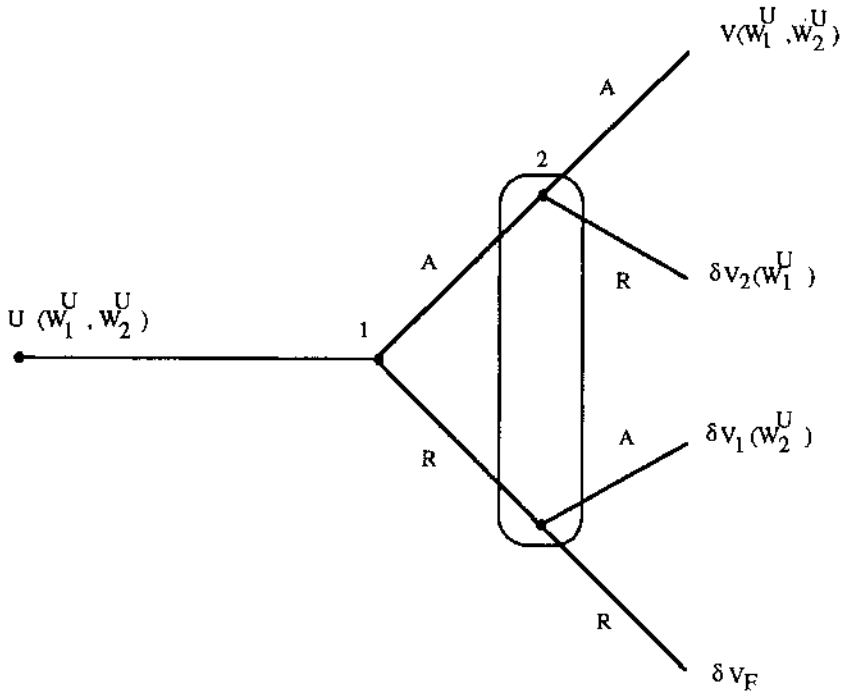
$$V_m(w_i) = \{\pi_i^m(w_i), 0, U_i[w_i, \ell_i^m(w_i)]\},$$

with

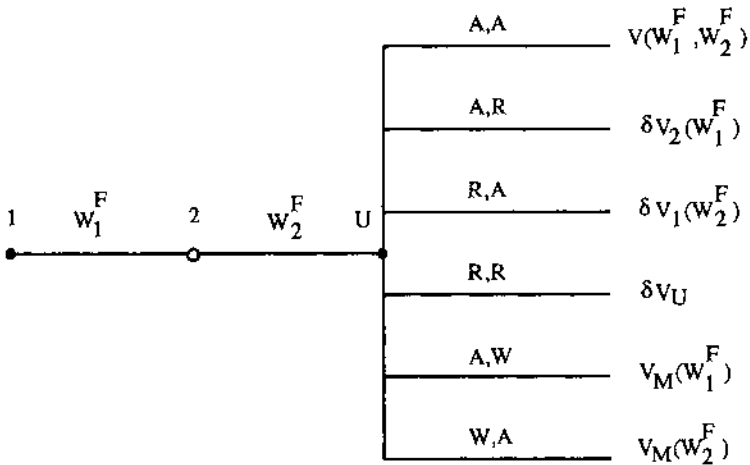
$$\pi_i^m(w_i) = \{D[\ell_i^m(w_i)] - w_i\} \ell_i^m(w_i).$$

The bargaining problem is represented in figure 2. In the initial period the union announces a wage vector (w_1^u, w_2^u) . Firm 1 and firm 2 simultaneously decide whether to accept or reject the appropriate wage offer (a circle around a set of nodes indicates that the decision is made at the same time as the decision at the previous node). If both wages are accepted, the payoffs are given by $V(w_1^u, w_2^u)$. If w_j^u is accepted and w_i^u is rejected, then, in the next period, firm i and the union will settle on the wage $w_i^i(w_j^u)$, and thus the payoffs will be given by $\delta V_i(w_j^u)$. If both wages are rejected, then in the next period the firms make their counteroffers, and it is as if the game was starting over with the firms moving first this time. Thus, the payoff is δV_F . Different values of V_F will lead to different optimal wage offers by the union and therefore, different values of V_u . Let $V_u(V_F)$ denote this functional relationship.

Now, consider the situation in which no agreement has been reached by time t and it is the firms' turn to make their offers, w_1^f and w_2^f , simultaneously. The union has six choices: accept both, leading to payoff vector $V(w_1^f, w_2^f)$; accept w_j and reject w_i , leading to payoff vector $\delta V_i(w_j^f)$ (for



The union announces wages (W_1^U, W_2^U) , the firms accept or reject



The firms announce wages (W_1^F, W_2^F) , the union accepts, rejects or withdraws

FIG. 2

$j = 1, 2$); reject both, leading to payoff vector δV_u ; or accept w_i and withdraw from the negotiations with firm j leading to payoff vector $V_m(w_i^f)$ (for $i = 1, 2$).¹² Different values of V_u will lead to different optimal wage offers by the firms and, therefore, different values of V_F . Let $V_F(V_u)$ denote this functional relationship.

Values (V_u, V_F) are equilibrium payoffs if $V_u[V_F(V_u)] = V_u$. The remainder of this section is devoted to describing the functions $V_F(V_u)$ and $V_u(V_F)$ and constructing the equilibrium. I focus on the case in which δ is arbitrarily close to (but below) one in order to find the limit equilibria. The case for any arbitrary value of δ is discussed in Davidson (1985).

A. Allowing the Firms to Make the Initial Offer

I begin by investigating the properties of $V_F(V_u)$. To do so, consider the problem faced by the union when the firms simultaneously offer w_1^f and w_2^f . The union must decide between four alternatives: (A, A) , (A, R) , (R, A) and (R, R) . (Values (A, W) and (W, A) are dominated by (A, R) and (R, A) respectively; see n. 12 above.) Figure 3 shows the union's optimal strategy for any vector (w_1^f, w_2^f) assuming that at least one wage is accepted. Suppose that a vector such as C is proposed. Rejection of w_1 and acceptance of w_2 will lead to vector D next period. Rejection of w_2 and acceptance of w_1 will lead to vector E next period. Since the union always prefers higher wages (over the relevant range), both vectors D and E are dominated by C . Therefore, (A, A) dominates (A, R) and (R, A) . Now, suppose that vector F is proposed. Acceptance of $w_1(w_2)$ and rejection of $w_2(w_1)$ will lead to vector $E(H)$ next period, and, since E dominates F and H , it follows that (A, R) dominates (A, A) and (R, A) . A similar argument can be used to show that (R, A) dominates (A, A) and (A, R) at vector G . Finally, consider vector J . Acceptance of $w_1(w_2)$ and rejection of $w_2(w_1)$ leads to vector $K(L)$ next period. Both K and L dominate J , and, since $w_1^L > w_1^K$ and $w_2^L > w_2^K$, L dominates K . Thus, below $w_2^L(w_1)$ and above the 45° line, (R, A) dominates (A, R) . A similar argument shows that, to the left of $w_1^L(w_2)$ and to the right of the 45° line, (A, R) dominates (R, A) . Along the 45° line, the union is indifferent between (A, R) and (R, A) , and thus I assume they play each strategy with equal probability.

Now, we must determine when the union's optimal response is (R, R) . This depends on the value of V_u . First compare (R, R) with (A, R) . The strategy (R, R) leads to a payoff of V_u , while (A, R) leads to a payoff of

¹² Note that either firm could conceivably withdraw from the negotiations as well. However, since the firm earns no profit if it withdraws, the strategy "continue bargaining" dominates the strategy "withdraw." This turns out to be true for the union as well: if the union plays (A, W) , it earns $V_m^1(w_1^f)$, while if it plays (A, R) it receives $\delta V_m^1(w_1^f) > V_m^1(w_1^f)$. Thus, (A, R) will dominate (A, W) , and no agent will ever withdraw from the negotiations.

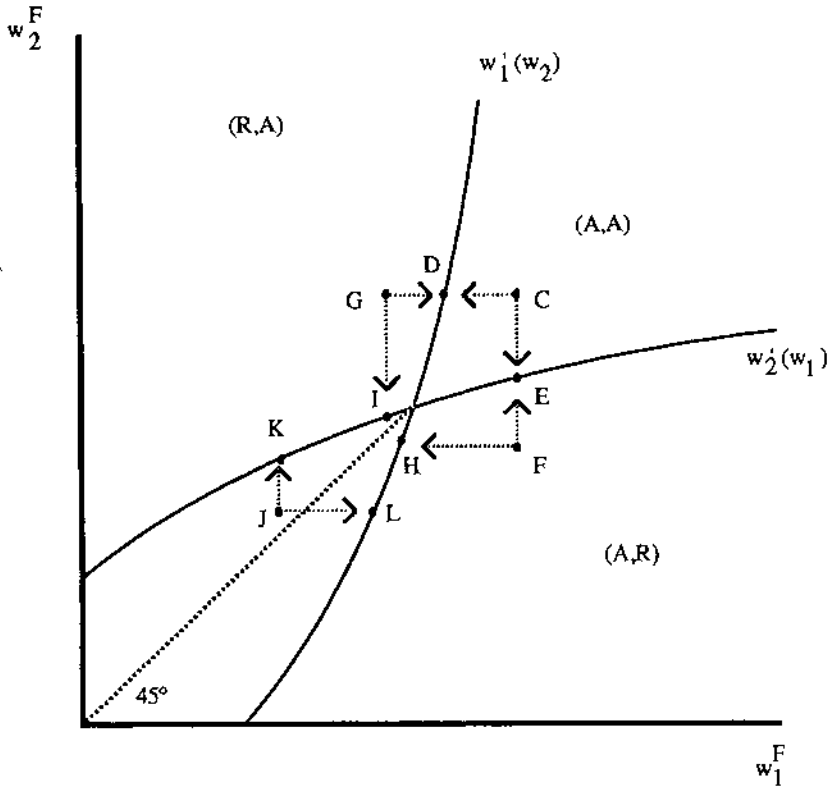


FIG. 3

$$U_1\{w_1^F, \ell_1[w_1^F, w_2'(w_1^F)]\} + U_2\{w_2'(w_1^F), \ell_2[w_2'(w_1^F), w_1^F]\},$$

which is an increasing function of w_1^F . Thus, there exists a critical value of w_1^F , say \hat{w}_1^F , at which this payoff equals V_u . For $w_1^F < \hat{w}_1^F$, (R, R) dominates (A, R) and, for $w_1^F \geq \hat{w}_1^F$, (A, R) dominates (R, R). By a similar argument, there exists a unique wage \hat{w}_2^F such that, if $w_2^F < \hat{w}_2^F$, (R, R) dominates (R, A), and, if $w_2^F \geq \hat{w}_2^F$, (R, A) dominates (R, R).

Finally, to compare the payoffs from (A, A) and (R, R), we can draw isoutility curves in (w_1^F, w_2^F) space. Since the union prefers higher wages, these curves are downward sloping. If we draw the isoutility curve for the utility level of V_u , then for all wage vectors below this curve (R, R) dominates, and for all wage vectors above the curves (A, A) dominates.

The union's strategy for any (w_1^F, w_2^F) is summarized in figure 4. In figure 4a, $V_u^3 < V^3(w_1^F, w_2^F)$, that is, V_u^3 is small, so that the (R, R) area is small. In figure 4b, V_u^3 is high ($V_u^3 > V^3(w_1^F, w_2^F)$), so that it takes much higher wage offers to get the union to accept.

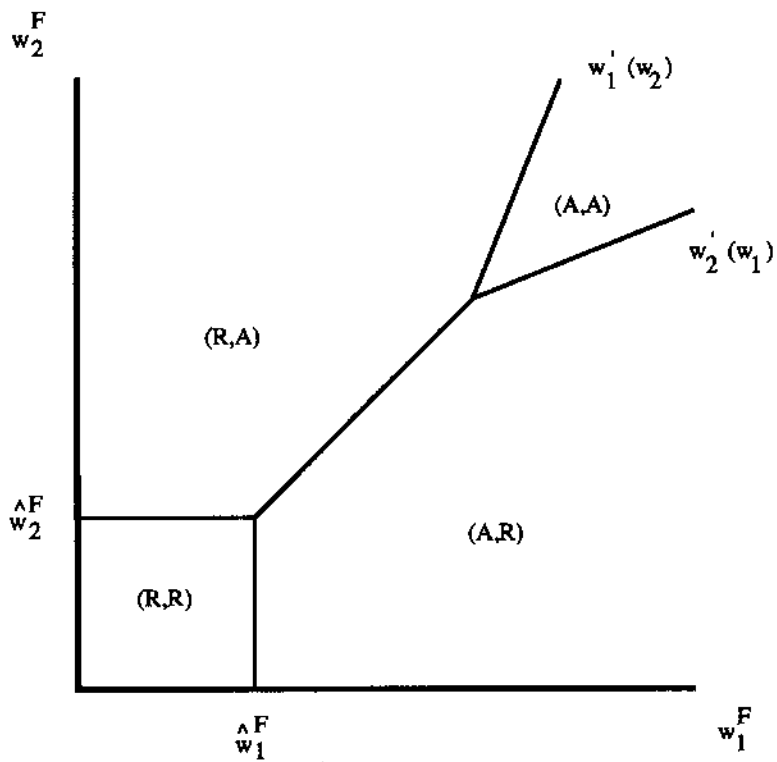


FIG. 4a

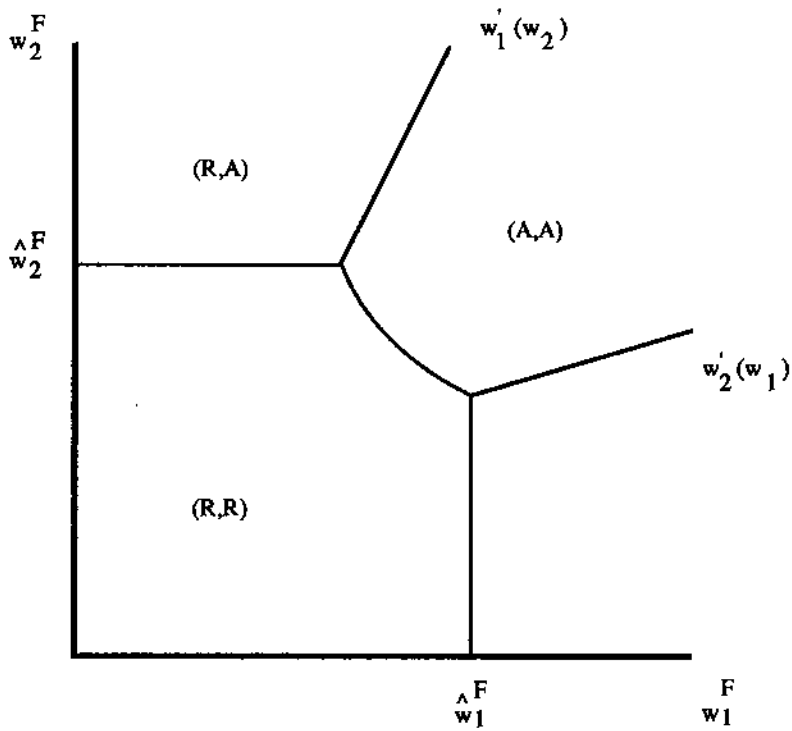


FIG. 4b

I now turn to the firm's problem. Since the firms act noncooperatively we must find a Nash equilibrium in wages (taking as given the strategy of the union). Suppose first that $V_u^3 \leq V^3(w'_1, w'_2)$, so that the union's strategy is given by figure 4a. To find the Nash equilibrium we must find firm i 's best reply for any w_j^f (i.e., firm i 's reaction function). The equilibrium wages are given by the intersection of the reaction functions.

To find firm 1's reaction function, consider figure 5a. For $w_2^f < \hat{w}_2^f$, only wages above \hat{w}_1^f will be accepted. Since $\pi_i(w_1, w_2)$ is decreasing in w_1 , firm 1's best response is \hat{w}_1^f (the lowest acceptable wage). Now, suppose $w_2^f \in (\hat{w}_2^f, w'_2)$ —for example, $w_2^f = w'_2$. Then, if firm 1 offers $w_1^f < w_2^f$, w_2^f will be accepted and w_1^f will be rejected, leading to wage vector C in the next period. If $w_1^f = w_2^f$ is offered, the union randomizes over (A, R) and (R, A), leading to vectors C and D with equal probability. However, if the firm offers $w_1^f = w_2^f + \epsilon$ with ϵ arbitrarily small but positive, we will end up at a wage vector arbitrarily close to (but to the right) of D. Clearly, the latter offer maximizes firm 1's payoff. Thus, for all $w_2^f \in (\hat{w}_2^f, w'_2)$ the best response by firm 1 is $w_2^f + \epsilon$. Finally, suppose $w_2^f \geq w'_2$ —for example, $w_2^f = \tilde{w}_2$. If firm 1 proposes $w_1^f < w'_1(\tilde{w}_2)$, it will be rejected, \tilde{w}_2 will be accepted, and we will end up at vector E. Thus, firm 1 may as well offer $w'_1(\tilde{w}_2)$ right away and have it accepted.

The reaction curves for firms 1 and 2 are depicted in figure 5b. Note that they cross only once—at (w'_1, w'_2) . These are the equilibrium wages when $V_u^3 \leq V^3(w'_1, w'_2)$.

Now, suppose $V_u^3 > V^3(w'_1, w'_2)$. Similar arguments yield the reaction curves in Figure 5c. Note that in this case any wage vector that is on the isoutility curve in the (A, A) region can occur in a Nash equilibrium. All such wages lead to the same level of utility for the union, V_u^3 , but different profits for the firms.

To summarize, let

$$\theta(V_u^3) = \{(w_1, w_2) \mid V^3(w_1, w_2) = V_u^3, w_1 \leq \hat{w}_1^f, w_2 \leq \hat{w}_2^f\}.$$

Then

$$V_F(V_u) = \begin{cases} V(w'_1, w'_2) & \text{if } V_u^3 \leq V^3(w'_1, w'_2), \\ V(w_1, w_2) & \forall (w_1, w_2) \in \theta(V_u^3) \text{ otherwise.} \end{cases}$$

B. Allowing the Unions to Make the Initial Offer

I turn now to the derivation of $V_u(V_F)$. Consider the problem faced by the firms when the union proposes (w_1^u, w_2^u) . Each firm must simultaneously decide whether to accept or reject their appropriate wage. But, their payoff from any strategy depends on their rival's response. Thus, we must calculate

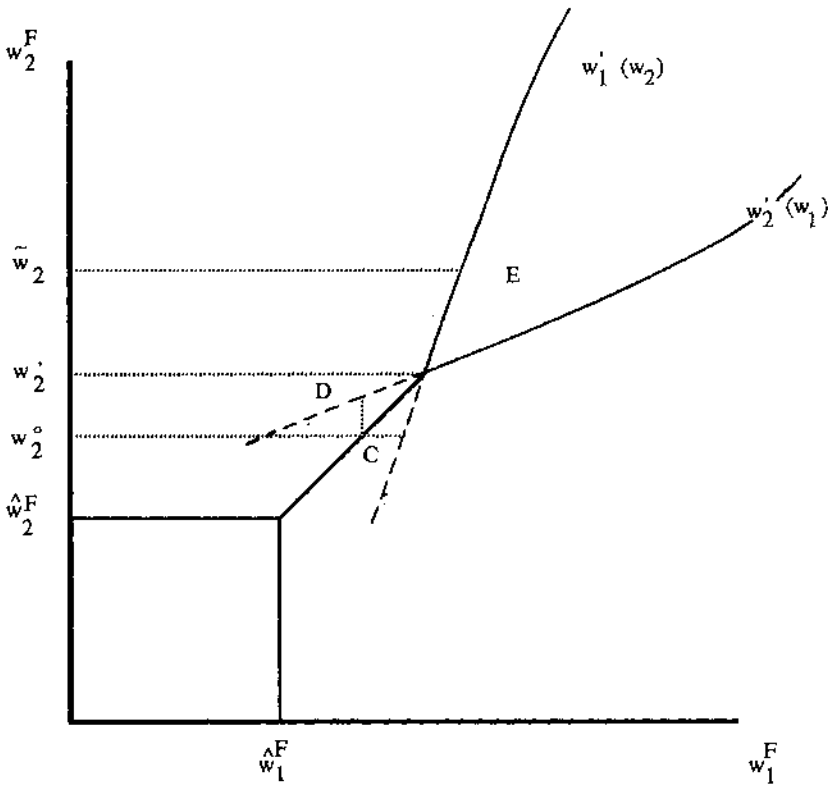


FIG. 5a

the Nash equilibrium for the firms in (A, R) space for any given (w_1^a, w_2^a) .

Suppose first that (w_1^a, w_2^a) is proposed and that firm 1 expects w_2^a to be accepted. Then, if it accepts w_1^a , it receives a payoff of $V^1(w_1^a, w_2^a)$ while, if it rejects w_1^a , it receives $V^1[w_1'(w_2^a), w_2^a]$ next period. Value $V^1(w_1^a, w_2^a) \geq V^1[w_1'(w_2^a), w_2^a]$ if and only if $w_1^a \leq w_1'(w_2^a)$. Thus, firm 1 accepts w_1^a if and only if $w_1^a \leq w_1'(w_2^a)$. By a similar argument, if firm two expects w_1^a to be accepted, it should accept w_2^a if and only if $w_2^a \leq w_2'(w_1^a)$. Therefore (A, A) is a Nash equilibrium if and only if $w_1^a \leq w_1'(w_2^a)$ and $w_2^a \leq w_2'(w_1^a)$ (see figs. 6a and 6b).

Now, suppose that firm 1 expects w_2^a to be rejected. Then if it accepts w_1^a it receives a payoff of $V^1[w_1^a, w_2'(w_1^a)]$ (next period), while if it rejects w_1^a it receives V^1 (next period). Since $V^1[w_1^a, w_2'(w_1^a)]$ is a decreasing function of w_1^a there will exist a unique \hat{w}_1^a , such that $V^1[\hat{w}_1^a, w_2'(\hat{w}_1^a)] = V^1$. For all $w_1^a \leq \hat{w}_1^a$, firm 1 will accept the wage, and for all $w_1^a > \hat{w}_1^a$, firm 1

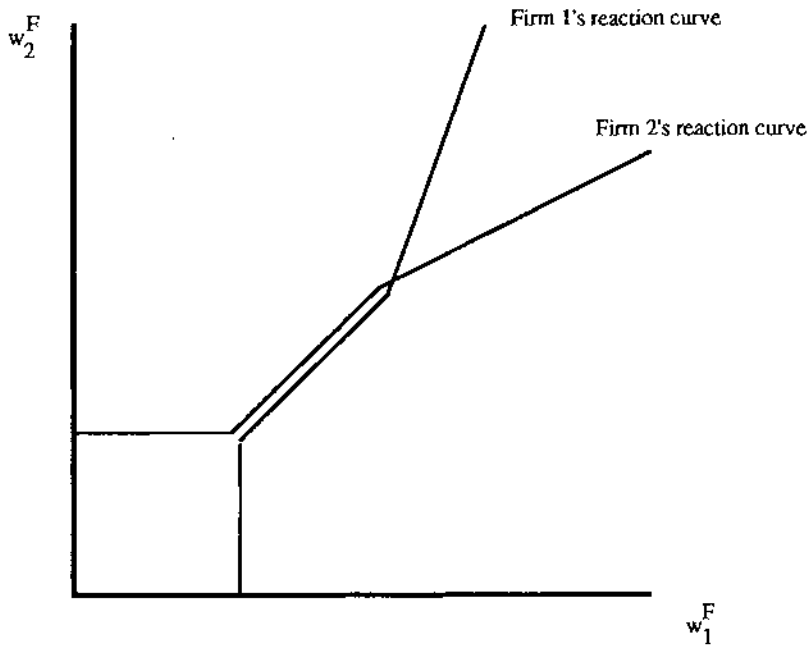


FIG. 5b

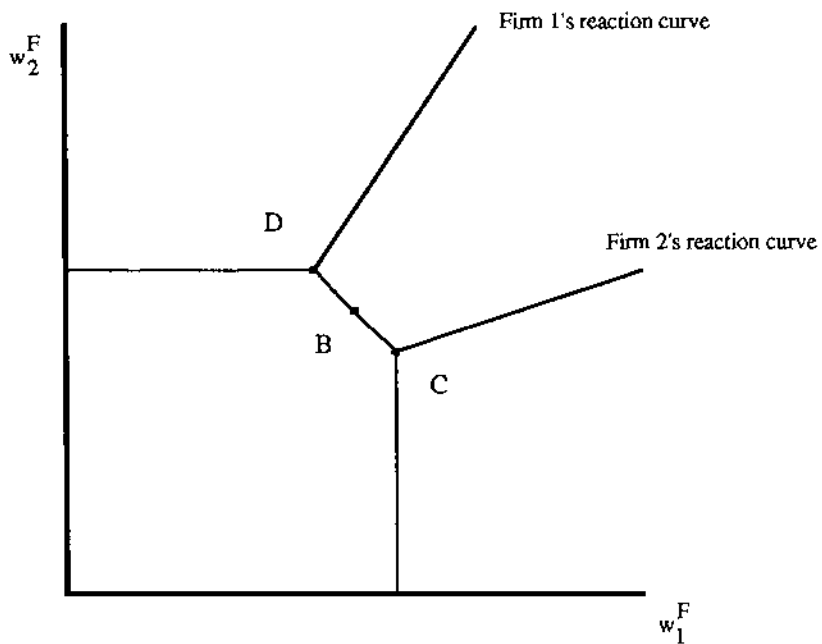


FIG. 5c

will reject the wage. If $w_1^* \leq \hat{w}_1^*$, firm 1 accepts (assuming w_2^* is rejected), and if $w_2^* \geq w_2'(w_1^*)$, firm 2 rejects (assuming w_1^* is accepted). Thus, (A, R) is a Nash equilibrium if and only if $w_1^* \leq \hat{w}_1^*$ and $w_2^* > w_2'(w_1^*)$ (see figs. 6a and 6b).

Define \hat{w}_2^* in an analogous manner. By a similar argument, (R, A) is a Nash equilibrium if and only if $w_2^* \leq \hat{w}_2^*$ and $w_1^* \geq w_1'(w_2^*)$ (see figs. 6a and 6b). Finally, (R, R) is a Nash equilibrium if and only if $w_1^* \geq \hat{w}_1^*$ and $w_2^* \geq \hat{w}_2^*$.

If $V_F^1 \geq V^1(w_1', w_2')$, then the appropriate figure is 6a. (The (R, R) region is large since V_F^1 is high.) Note that in the shaded region both (A, A) and (R, R) are Nash equilibria. If $V_F^1 \leq V^1(w_1', w_2')$, figure 6b is appropriate. In this case (A, R) and (R, A) are both Nash equilibria in the shaded area.

Now, consider the union's problem of choosing the optimal wage vector (w_1^*, w_2^*) , taking as given the firm's Nash equilibrium strategies. Suppose first that $V_F^1 \geq V^1(w_1', w_2')$, so that figure 6a is appropriate. If we assume that (R, R) is the Nash equilibrium in the shaded region, then the highest acceptable wages are $(\hat{w}_1^*, \hat{w}_2^*)$. If (A, A) is the Nash equilibrium in this region, then (w_1', w_2') are the highest acceptable wages. By partitioning the shaded area appropriately into (A, A) and (R, R) , any wages between $(\hat{w}_1^*, \hat{w}_2^*)$ and (w_1', w_2') can be supported in equilibrium.

Now, suppose $V_F^1 \leq V^1(w_1', w_2')$, so that figure 6b is appropriate. If (A, R) is taken as the Nash equilibrium in the shaded region, then $[\hat{w}_1^*, w_2'(\hat{w}_1^*)]$ is the highest acceptable wage vector. If we assume (R, A) is the Nash equilibrium in this region, then $[w_1'(\hat{w}_2^*), \hat{w}_2^*]$ is the highest acceptable wage vector. The wage offer that leads to these equilibrium wage vectors is given by 0 in Figure 6b. No other wage vectors can be supported in equilibrium.

To summarize, let

$$\begin{aligned} \phi(V_F^1) = & [(w_1, w_2) | (w_1, w_2) \geq (\hat{w}_1^*, \hat{w}_2^*), w_1 \leq w_1'(w_2), \\ & w_2 \leq w_2'(w_1), (w_1, w_2) \leq (w_1', w_2')]. \end{aligned}$$

Then

$$V_u(V_F) = \begin{cases} V(w_1, w_2) & \forall (w_1, w_2) \in \phi(V_F^1) \\ & \text{if } V_F^1 \geq V^1(w_1', w_2'), \\ V[\hat{w}_1^*, w_2'(\hat{w}_1^*)] \text{ or } V[w_1'(\hat{w}_2^*), \hat{w}_2^*] & \text{otherwise.} \end{cases}$$

C. Equilibrium

I am now in a position to derive the perfect equilibrium wages in this bargaining model. To do so I choose an arbitrary payoff vector, V_u , and solve for the equilibrium wages in the game in which the firms move first (assuming that (R, R) leads to payoff δV_u). These wages define V_F , which

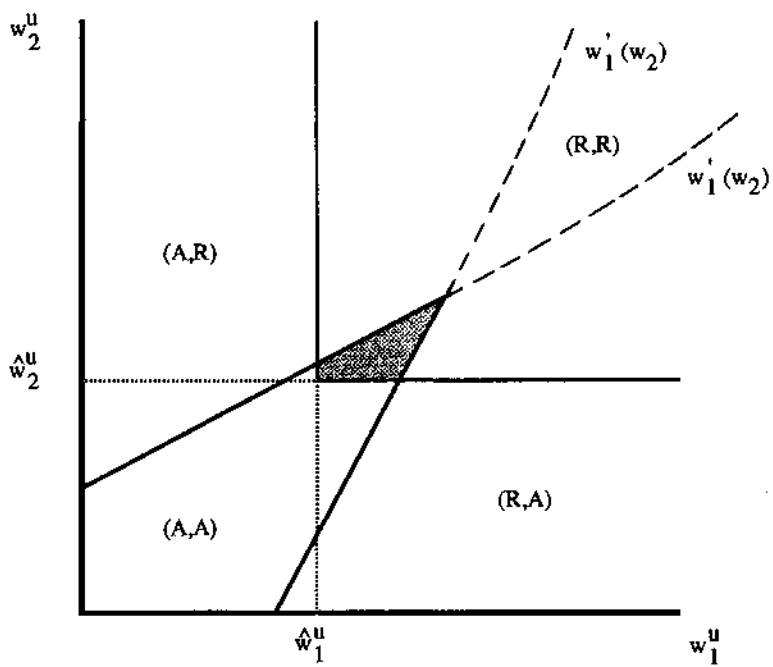


FIG. 6a

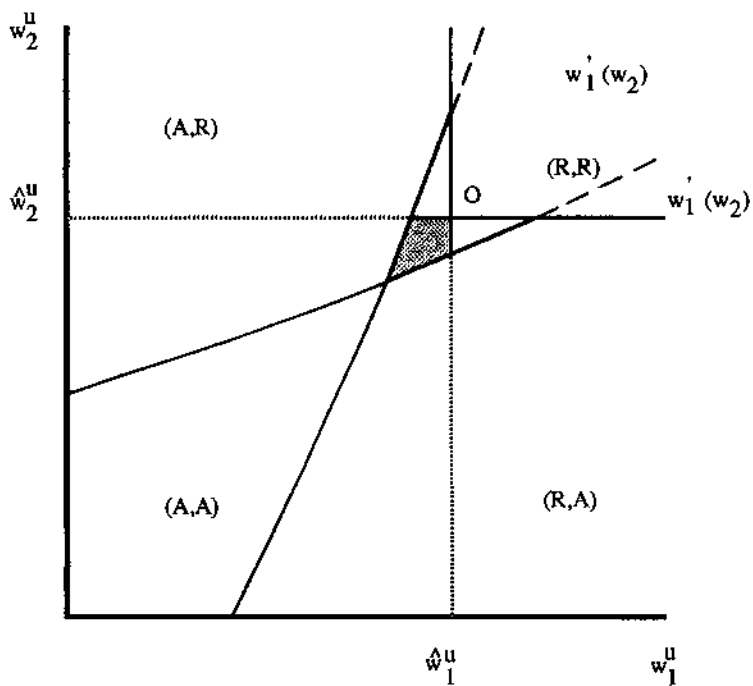


FIG. 6b

can then be used to find the equilibrium wages in the game in which the union moves first (assuming that (R, R) leads to payoff δV_F). These wages define a new value for V_u , which, if it equals the original (arbitrarily chosen) value of V_u , represents the equilibrium payoff vector for the game. For this to be true, of course, the equilibrium wage vectors in the two games would have to be identical.

DEFINITION 2. Values (w_1, w_2) are perfect equilibrium wages if $V_u\{V_F[V(w_1, w_2)]\} = V(w_1, w_2)$.

Suppose first that $V_u^3 \leq V^3(w'_1, w'_2)$, so that figures 4a and 5b apply. Then, as I have shown above, $V_F(V_u) = V(w'_1, w'_2)$. That is, when the firms make the initial offers, the equilibrium wage offers are (w'_1, w'_2) . These wages lead to a payoff vector V_F with $V_F = V_F^3 = V^3(w'_1, w'_2)$. Now, taking this V_F vector as given, consider the game in which the union moves first. For this value of V_F , it is clear that $w_1^* = w'_1$ in figure 6a, and, therefore, the highest acceptable wages are (w'_1, w'_2) . Thus, $V_u[V_F(w'_1, w'_2)] = V(w'_1, w'_2)$, and (w'_1, w'_2) are the only perfect equilibrium wages with the property $V_u^3 \leq V^3(w'_1, w'_2)$.

Next, suppose that $V_u^3 > V^3(w'_1, w'_2)$, so that figures 4b and 5c apply. I will show that there exist no perfect equilibrium wage vectors satisfying this condition. To do so, consider the game in which the firms move first. As shown above, in this case any wage vector on the segment DC in figure 5c can be supported in equilibrium (taking V_u^3 as given). It is important to note that DC lies everywhere above vector (w'_1, w'_2) . Now, consider the game in which the union moves first, and assume that the union offers a wage vector on DC . This vector will be a perfect equilibrium wage vector only if both firms find the wage offer acceptable. However, I have shown above that (A, A) is *never* a Nash equilibrium for the firms when the wage vector offered lies above (w'_1, w'_2) . Therefore, no vector along DC is a perfect equilibrium wage vector, and no perfect equilibrium exists that satisfies $V_u^3 > V^3(w'_1, w'_2)$.

My results can now be summarized:

PROPOSITION 1. Suppose the unions merge to form an industrywide union and that at least one pair of perfect equilibrium wages exists. Then there is a *unique* perfect equilibrium wage vector (w'_1, w'_2) with $w'_1 = w'_1(w'_2)$ and $w'_2 = w'_2(w'_1)$. In addition, these wages are proposed and accepted in the initial period.

It is important to note that equilibrium is unique. One usually expects a bargaining problem to generate an embarrassingly large number of equilibria. This is not the case here, however, as (w'_1, w'_2) represent the only set of perfect equilibrium wages. Finally, note that I did not exploit the assumptions of identical tastes and preferences in deriving equilibrium or proving uniqueness and, therefore, these results are independent of these assumptions.

V. Collective Bargaining with Independent Unions

To derive the equilibrium wages under independent bargaining, a method similar to the one used in Section IV can be applied. The only difference is that when the unions move they now act noncooperatively, and, therefore, it is necessary to solve for a Nash equilibrium in their strategies. However, as in Section IV, the *unique* equilibrium wage vector is completely determined by the outcome of the subgames in which one wage has been accepted and the other remains to be determined. Therefore, since the analysis so closely parallels that of Section IV, I simply report the results and prove that (w_1^*, w_2^*) is a perfect Nash equilibrium wage vector.

PROPOSITION 2. Suppose the unions act noncooperatively and that there exists at least one pair of perfect equilibrium wages. Then there is a unique perfect equilibrium wage vector (w_1^*, w_2^*) with $w_1^* = w_1^*(w_2^*)$ and $w_2^* = w_2^*(w_1^*)$. These wages are proposed and accepted in the initial period.

Proof. That (w_1^*, w_2^*) are perfect equilibrium wages is easily established: suppose that firm i and its union expect w_j^* to be offered and accepted in the first period. Then, if union i proposes any $w_i > w_i^*(w_j^*) = w_i^*$, the firm will reject it since, by waiting one (very short) period they know they will have to pay only $w_i^*(w_j^*)$. Thus, the union proposes the highest acceptable wage, which is w_i^* . Reverse the argument to establish that union j will propose w_j^* if it expects w_i^* to be proposed and accepted at firm i . Since, in both instances, the players base their actions on expectations that are correct, we have an equilibrium. To guarantee that this equilibrium is stable I require $w_1^*(w_2^*)$ to be steeper than $w_2^*(w_1^*)$.¹³ The proof of uniqueness is a straightforward extension of the proof of uniqueness in Proposition 1 and is therefore omitted. Q.E.D.

I have already shown (in Sec. III) that the subgame wages will be lower when the unions act noncooperatively. Therefore, industrywide bargaining leads to higher wages. This, in turn, benefits the unions and lowers the profits firms earn.

PROPOSITION 3. Industrywide bargaining results in higher wages throughout the industry. This benefits both unions and reduces the profits of both firms.

Proof. The result that industrywide bargaining increases wages follows immediately from Propositions 1 and 2 and figure 1.

To prove that the firms are worse off, note that the equilibrium is symmetric (since both unions have the same utility function and both firms possess the same technology). Thus, both wages rise by the same amount and, since the own effect dominates the cross effect (eq. [10]), the profits at both firms decline.

¹³ The same approach laid out in Friedman (1977, pp. 70–74) can be followed to prove stability.

Finally, consider the union: w'_1 and w'_2 are both accepted if proposed in the first period and, since (w_1^*, w_2^*) lead to higher profits for both firms, they will be acceptable as well. However, (w_1^*, w_2^*) are not offered, (w'_1, w'_2) are, and therefore (w'_1, w'_2) must lead to higher utility for the union. Q.E.D.

The only result in Propositions 2 and 3 that depends on symmetry across firms and unions is the result that the unions benefit and the firms lose because of industrywide bargaining. If the market is not symmetric, the positive effect of the increase in w_i could outweigh the negative effect of the increase in w_j on π_i . Thus, one firm might benefit from industrywide unionization.

The fact that the unions benefit by cooperating with each other is hardly surprising and, at first blush, appears to be analogous to the result that firms can increase their profits by colluding in the product market. However, there is a subtle difference between industrywide unions and cartels. Industrywide unions have no stability problems while it is necessary to police cartels in order to keep them from dissolving. To see this, consider the forces that lead to the higher payoffs in each case. When a firm restricts output in a collusive agreement, it is the *other* firms in the industry that benefit (since price rises) while the firm actually loses since it is moving away from its initial profit-maximizing output level. Each firm benefits from the agreement since the increase in profits due to all the other firms restricting output outweighs the loss in profits because of its own reduction in production. However, since the firm would be better off if it could get everyone else to restrict output without doing so itself, such agreements create incentives for individual firms to cheat on the cartel. Thus, cartels may dissolve if these incentives to cheat are strong enough.

Now, consider the effects of industrywide bargaining. When a union succeeds in securing a higher wage rate, all of the workers in the industry benefit. The workers at other firms benefit since their firm becomes more profitable, and employment increases while the workers at the firm benefit from the higher wage. Thus, when the unions cooperate there are no incentives for individual groups of workers to cheat on the agreement. That is, the collusive agreement is inherently stable. This may help to explain why industrywide unions tend to be strong, stable organizations, while collusive agreements in product markets often break down.

There are two other possible bargaining structures that we could consider: one in which the firms act cooperatively and the unions bargain non-cooperatively, and one in which the unions and firms are each represented by a single bargaining agent with these two agents meeting to determine the wages. Similar, but less clear-cut, results can be obtained when examining these bargaining structures. For example, in the case in which the firms collude during negotiations (in order to maximize joint profits) and the unions bargain independently, the effect on wages is indeterminate.

By joining forces the firms increase their bargaining power (by reducing the cost of a strike) and can therefore push for lower wages. However, a negative externality is internalized ($\partial\pi_i/\partial w_j > 0$), which tends to put upward pressure on wages. The overall effect is therefore ambiguous (the empirical work of Hendricks [1975] suggests that the former effect dominates). And, finally, if I compare the two extreme cases—total noncooperative behavior among the four agents to the case in which an industrywide union negotiates with a single agent representing both firms—wages are likely to be higher in the latter case (although it is possible that they may be lower if the firms' bargaining power increases significantly more than the unions').

Note that collusive agreements among firms may be unstable since increases in wages that occur when internalizing the externality harm the firm that is paying the higher wage. This may provide an explanation for the fact that industrywide unions are much more prevalent than multiemployer bargaining units (e.g., the trucking industry's common-bargaining unit recently disintegrated).

VI. Conclusion

In this article I showed how recent advances in noncooperative bargaining theory can be applied to investigate the relation between bargaining structure and contract settlements in oligopolistic industries. In doing so, I found that industrywide bargaining leads to higher wages for two reasons. First, if a firm agrees to pay a higher wage, its competitive position in the output market will be weakened and its competitors will respond by increasing employment. This positive externality across firms (from the unions' perspective) is internalized when an industrywide union forms. Therefore, the industrywide union holds out for a higher wage. Second, the cost of a strike is lower for an industrywide union than an independent union. If, for example, the industrywide union strikes a firm i , firm j responds by increasing production and employment. This partially offsets the union's loss in utility due to the strike. This reduction in strike costs enhances the union's bargaining power and leads to even higher wages.

While the result that cooperation across unions leads to higher wages is hardly surprising, my analysis produced two other results that could not be anticipated. First, I demonstrated that, in a noncooperative bargaining game in which each firm and the union representing its workers exchange wage offers until an offer is made that is acceptable to both sides, there is a *unique* perfect equilibrium wage vector that is proposed and accepted in the initial period. The fact that this natural bargaining process has only one equilibrium is surprising in light of the embarrassingly large number of equilibria generated by most bargaining models. Second, I demonstrated that industrywide unions are inherently stable in that there are no incentives for independent unions to attempt to cheat on the collusive agreement. Therefore, unlike product market cartels, cooperative agree-

ments across unions do not need to be policed. In contrast, cooperative bargaining agreements across firms are likely to be unstable. This leads to the conclusion that multiunit-bargaining arrangements across unions should be more durable than those across firms.

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