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NEW PREDICTIONS FROM THE ECONOMICS OF UNIONISM*

by

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Labor markets in which unions figure prominently have long been a focus of interest for labor economists. Indeed the past decade witnessed an enormous increase in the stock of knowledge about unionized environments.[1] Despite the gains that have been made, the existing body of theory suffers from two basic limitations. First, the models that are available offer very few testable propositions, rendering the process of discriminating among competing alternatives extremely difficult; see Brown and Ashenfelter (1986), Eberts and Stone (1986) and MaCurdy and Pencavel (1986). Second, though linked by a common focus on unions, the literature is highly fragmentary; models in which a variety of issues may be addressed simultaneously are notable by their absence. Rather, the tendency has been towards utilization of distinct models to analyze separate topics. Compare, for example, the models used to explain the pattern of intertemporal incidence of unions (Ashenfelter and Pencavel, 1969; Freeman, 1984), union–nonunion wage differentials by industry (Parsley, 1980), and strikes (Hayes, 1984). This disparate approach has ruled out a potentially fruitful source of predictions—namely restrictions on the covariation of several endogenous variables considered together—in addition to impeding the development of a coherent view of the whole set of union issues.

This paper develops a simple model that offers a surprisingly rich body of hypotheses about labor markets in which unionism is an important element. Because the model is so simple, extension to encompass omitted issues is generally very straightforward.

The basic structure of the model is not much different from many existing models. A union confronts a collection of firms who employ labor to produce a product sold to consumers. Firms seek to maximize profits, and workers behave so as to maximize utility. At first, the union's objective is a very general one that subsumes many specifications, and has just one relevant restriction: all else constant, the union would prefer higher wages. The union optimizes by determining its membership and the features of a contract offered to firms, subject to several constraints implied by the optimizing behavior of firms and workers.

In Section I, two versions of the general model are explored. In one, the union contract specifies a wage rate, and leaves employment to the firms' discretion: a "monopoly union". It is shown that under reasonable circumstances union coverage will be incomplete in equilibrium: the union will permit a limited number of firms to operate while employing nonunion labor.[2] When coverage is incomplete, a very strong prediction emerges: union wages, membership, dues, and number of firms organized are independent of demand for the product produced by firms in the industry. All variations in demand (unless so large as to render coverage complete) are absorbed by changes in nonunion employment. Some discussion of how this prediction can most effectively be tested is provided.

The second version of the general model permits the union contract to specify a wage and employment pair, where the contract is chosen to maximize the union's objective given a level of profits for unionized firms (and the other constraints mentioned above): "efficient unionism".[3] In this setting, coverage can never be incomplete in equilibrium. The elements that caused incomplete coverage to be maximal in the first version are not operative in the efficient union setting. As a consequence, union wages, dues, etc. must always be dependent on demand.

To generate further predictions, in Section II the model is given more structure; in particular, the union's objective is specialized to maximization of net revenue. To illustrate in a compact fashion the kind of results available, attention is restricted to the effect of changing alternatives for unionized workers (i.e. varying the opportunity wage) under incomplete coverage. (More results are available in the authors' 1985 paper.) It is shown that under mild restrictions an increase in the value of the alternative raises the union wage as well as the union–nonunion differential, and lowers both the number of unionized firms and union membership. Other implications are that the union's total revenue declines, as does the aggregate output of unionized firms, and union labor's share in factor payments.

In Section II it is also demonstrated that the model can easily be enriched to include other union–related issues: productivity effects, strikes and effects on skill accumulation in particular. Finally, it is argued that the comparative–statics experiments imply other results that can be tested using more limited data than would otherwise be required and the model is employed to interpret some existing empirical results on the elasticity of substitution, industry level wage regressions and union wage "rigidities".

Section III concludes.

I. A GENERAL MODEL AND RESULT

This Section presents a general model of an industry in which a union, firms, workers, and consumers interact. Initially, the model is one of monopoly unionism, in which the union may specify unilaterally the wage at which unionized labor is traded, but cannot dictate the quantity of labor used by any unionized firm at that wage. In this context two propositions are demonstrated: i) incomplete union coverage—i.e. not all workers employed in the industry will be unionized—will be a feature of equilibrium under some circumstances, and ii) that when such is the case, union wages, dues, and membership are independent of product demand.

The model is then modified to a situation in which wages, dues and employment are efficient in the sense of providing the union the greatest payoff possible subject to a given level of profit for unionized firms: efficient unionism. It is then shown that union coverage may never be incomplete in equilibrium, and that union wages and employment are always dependent on product demand. Finally, some attention is devoted to tests of the differentiating hypothesis that union behavior should be independent of product demand conditions.

Underlying the strong conclusions obtained in this section is an assumption concerning the union's power that should be emphasized at the start: the union may organize any firm if it is advantageous to do so, and likewise, can permit or refuse membership to any worker if it so chooses. That some assumption of this kind is critical is almost self evident. If any firm may produce using nonunion labor when it pays to, unionized firms can never earn nonnegative profits if the union wage exceeds the nonunion wage.[4] Unionized firms, hence positive union coverage, could therefore never be part of an equilibrium in which unionized workers earn higher wages. The union must therefore "protect" union firms in some fashion. That the union at least has the option of organizing firms that would produce if they could do so using nonunion workers is a necessary condition for effective protection. In a similar fashion, if the union were obliged to admit and find employment at the union wage for any worker who approached it, a union wage (net of dues) in excess of the nonunion wage could never be sustained. The ability to limit membership may prove necessary.[5]

An assumption of this kind would seem to be implicit in all models of union–firm interaction in which the union (or unionized workers) earns rents that are collected through employment. In the present context, however, while this assumption is no more necessary than usual, the possibility of incomplete coverage means that it plays a more visible role than is typical. If incomplete coverage is to be possible, the union must find it to its advantage to permit such to occur; that is, it must allow some number of firms to operate in the industry and purchase labor at the nonunion wage. But, as discussed above, this number cannot be unlimited if unionized firms are to survive. Thus, the union must allow only some limited number of nonunion firms to produce, and indicate that any other firms who might plan to produce using nonunion workers (i.e. "potential entrants") will instead be unionized if they produce. For this threat to be taken seriously, it must be possible for the union to organize a firm if it seeks to—hence the assumption. Of course, it must also be the case that the union would in fact organize an entrant if called upon to do so. This latter "credibility" requirement will be a feature of the equilibrium displayed below.[6] The formal analysis follows.

A. Monopoly Unionism

The demand side of the market for industry output is represented by a demand function $D(p)$, where p is the unit price of output. $D(p)$ is twice continuously differentiable and downward sloping with $D(0) < \infty$ and $D(p) = 0$ for sufficiently large p.[7]

There are a large number of both workers and firms. For simplicity, all workers are taken to be identical. Moreover, there are no specialized factors of production, in which case firms are also identical and in infinitely elastic supply to the industry. Finally, workers do not attach any value to being in the union per se apart from improved wages, and the union has no direct role in production. Under these assumptions, the specification of the maximization problems confronting workers and firms is straightforward.

Before proceeding, the structure of the interaction among the union, workers and firms has to be laid out. Owing to the fact that the union must protect union firms and limit membership, it is evident that the formal specification necessarily permits the union to communicate explicitly with unorganized firms and nonunion workers; the model allows this direct communication. In practical terms, no such open communication need be undertaken. Rather, the union would be expected to have a "policy" regarding its willingness to admit new members and "plans" for organization of new firms.

The explicit communication procedes as follows. The union designates a union wage w and labels firms and workers in the following manner: N^u firms are declared "unionized", and thus must pay each of their workers w if production is undertaken; N^n firms are labelled "nonunion" and may produce using nonunion labor and pay the nonunion wage, $\bar{w}$. All other firms are designated "not in the industry", and threatened with unionization should they produce. In a like manner, L^u workers are admitted to the union if they seek membership, and are "union" workers; L^n are "nonunion", and may work wherever they wish apart from unionized firms. All others are "not in the industry".

Given the union's actions, how do firms and workers behave?

All firms have access to the same technology, and maximize profit by appropriate choice of inputs (including labor) taking as given the value of output and factor prices. The price of labor is w for unionized firms and $\bar{w}$ otherwise. At this level of generality the firm's optimization may be summarized by the profit function $\pi(p,\hat{w})$, where $\hat{w} = w$ or $\bar{w}$ as appropriate.[8] (That the union has no direct role in production implies that union and nonunion firms have the same profit function). $\pi(p,\hat{w})$ is assumed twice continuously differentiable and convex, with $\partial\pi(p,\hat{w})/\partial p \equiv q(p,\hat{w}) > 0$ being the firm's (upward sloping) supply curve, and $\partial\pi(p,\hat{w})/\partial\hat{w} \equiv -l(p,\hat{w})$ being (downward sloping) labor demand.

A union firm has two options: production using union labor, or a zero profit alternative. That is, the firm's having been organized rules out production with nonunion workers in the industry in question. For union firms to be willing to produce, it is therefore required that

(1) $\quad \pi(p,w) \geq 0.$

Similarly, nonunion firms must be willing to produce using nonunion labor:

(2) $\quad \pi(p,\bar{w}) \geq \max\,\{0,\, \pi(p,w)\}.$

Finally, for those firms designated "not in the industry", this option must dominate being organized (nonunion operation is not permitted):

(3) $\quad 0 \geq \pi(p,w).$

(1) and (3) taken together give the constraint

(1′) $\quad \pi(p,w) = 0.$

That is, unionized firms must earn exactly zero profit. Any smaller profit yields no production; any more turns the threat of union organization into an invitation. Given (1′), (2) becomes

(2′) $\quad \pi(p,\bar{w}) \geq 0.$

(1′) and (2′) are constraints on union behaviour implied by optimization on the part of firms. The complete collection of constraints from firm behaviour also includes $\partial\pi(p,\hat{w})/\partial\hat{w} = -l(p,\hat{w})$ and $\partial\pi(p,\hat{w})/\partial p = q(p,\hat{w})$.

Turning to the behavior of workers, all have an alternative yielding utility $\bar{V}$. Work in the industry generates (indirect) utility $v(\tilde{w})$, where $\tilde{w}$ is compensation: $\bar{w}$ for nonunion workers, $w-d$ for union workers, with d the level of dues. $v(\cdot)$ is twice continuously differentiable, with $v' > 0$. Given the union's power to limit membership, a nonunion worker's alternative is to work elsewhere, yielding

$$v(\bar{w}) \geq \bar{V}$$

as a constraint. Since $\bar{w}$ is the competitive wage, $\bar{w}$ must be such that this constraint holds as equality:

$$(4) \qquad v(\bar{w}) = \bar{V}.$$

Since union workers may work elsewhere if they please,

$$(5) \qquad v(w-d) \geq \max\{v(\bar{w}), \bar{V}\} = \bar{V}$$

must hold as well, in which case $w \geq \bar{w}$ is implied on the assumption that workers' interest in the union is monetary. Observe that when $w \geq \bar{w}$, (2′) becomes redundant given (1′).

Overall then, optimizing behavior (with respect to participation) on the part of workers and firms yields two restrictions on the behavior of the union:

$$(1') \qquad \pi(p,w) = 0$$

and

$$(5) \qquad v(w-d) \geq \bar{V}.$$

Note that when $w > \bar{w}$, if any nonunion firms operate in equilibrium, they will earn strictly positive profit. This outcome is a reflection of the fact that in the present model the union has but one tool with which to collect rents from firms, and that it therefore may not succeed in collecting all rents. That nonunion firms obtain part of the rents is incidental.[9]

Given the behavior of workers and firms, the union's problem may be set out.

What is the union's objective? Despite much discussion, and although reasonable cases in favor of several alternatives may be constructed, to date no compelling argument for any particular specification has been forthcoming. Fortunately, the general results hold for the very general objective

$$u(w,d,N^u,L^u,\bar{w}),$$

with $\partial u/\partial w > 0$. Special cases of u(·) include (i) the standard wage and total employment specification, $u(w,L^u)$, or its wage bill version $u(wL^u)$; (ii) total "rents" $(w-\bar{w})L^u$; (iii) total rents less costs of organization and operation $(w-\bar{w})L^u - c(N^u,L^u)$ where c(·) takes account of the notion that costs will generally depend not only on how many members the union has, but also their distribution across firms; (iv) the net revenue maximizing union $dL^u - c(N^u,L^u)$ with $d \leq w - \bar{w}$ (i.e. $v(w-d) \geq \bar{V}$); and (v) total resources that might be distributed to union members, subject to dues covering costs of operation: wL^u subject to $dL^u \geq c(N^u,L^u)$; and so on.

The union's optimization is subject to a number of constraints:

(6) $\pi(p,w) = 0,$

(7a) $L^u = N^u l(p,w),$

(7b) $L^n = N^n l(p,\bar{w}),$

(8) $v(w\text{-}d) \geq \bar{V},$

and

(9) $N^u q(p,w) + N^n q(p,\bar{w}) = D(p)$

(6) and (8) have been discussed above. For subsequent manipulation, it is helpful to solve (6) for $p = p(w)$. That $\partial\pi(p,w) = q(p,w) > 0$ guarantees that this procedure may be carried out. $p(w)$ will then be substituted into the other constraints, eliminating (6). (7a) requires that union membership equal employment in unionized firms, i.e. that all union members work,[10] and (7b) imposes the same restriction for nonunion workers and firms within the industry. Again, $-l(p,\hat{w}) = \partial\pi(p,\hat{w})/\partial\hat{w}$ for any $\hat{w}$. Because L^n does not appear in either $u(\cdot)$ or any other constraint, L^n can always be chosen to satisfy (7b). Thus (7b) will be ignored

subsequently. (9) simply states that the product market must clear.

The union's problem is thus to choose w, d, N^u, and L^u to

$$\max\ u(w,d,N^u,L^u,\bar{w})$$

subject to

(10) $L^u = N^u l[p(w),w]$,

(8) $v(w-d) \geq \bar{V}$,

(11) $N^u q[p(w),w] + N^n q[p(w),\bar{w}] = D[p(w)]$,

$N^u \geq 0$,

and

$N^n \geq 0$.

Supposing the union's problem has a solution, the issue of the credibility of the union's threats to organize any entrant and refuse membership to any nonunion worker may now be discussed.[11] Because N^u and L^u are chosen optimally by the union, any small change in N^u or L^u that satisfies the constraints yields no change in value of the union's objective (by the Envelope theorem). Accordingly, given that the union cannot ignore any of the constraints it faces, it would be quite content to unionize any single firm, or refuse membership to any single worker. This simple (envelope) argument relies on the competitive notion that no firm or worker is large relative to the market. A more complex (game theoretic) argument can be constructed that shows that the union can in fact credibly threaten larger firms (or coalitions of firms) or groups of workers.

To proceed further, consider whether the union will select incomplete union converge: $N^n > 0$. Observe that N^n enters the union's problem only via (11), the market clearing condition. It therefore follows that a condition equivalent to incomplete union coverage is that (11) with $N^n \geq 0$ incorporated—

(11′) $N^u q[p(w),w] \geq D[p(w)]$

—not be binding at the union's optimum. For this condition to hold, the union's problem must have a solution when (11′) is simply ignored. Whether $N^n > 0$ then depends purely on the location of $D(p)$. If the union's problem has a solution ignoring (11′), a demand function $D(p)$ can always be found so that $N^n > 0$.

More information can be obtained through explicit characterization of the union's problem when (11′) is not binding. Substitution of (10) in $u(\cdot)$ gives the Lagrangean

$$L(w,d,N^u,L^u,\lambda) = u\{w,d,N^u,N^u l[p(w),w],\bar{w}\} + \lambda[v(w\text{-}d) - \bar{V}],$$

where λ is a Lagrange multiplier.

First order necessary conditions for an interior maximum are:

$$(12)\quad \frac{\partial u}{\partial w} + \frac{\partial u}{\partial L^u} \cdot N^u\left[\frac{\partial l}{\partial p}p' + \frac{\partial l}{\partial w}\right] + \lambda v' = 0,$$

$$(13)\quad \frac{\partial u}{\partial d} - \lambda v' = 0,$$

$$(14)\quad \frac{\partial u}{\partial N^u} + \frac{\partial u}{\partial L^u}\, l[p(w),w] = 0,$$

and

$$(8)\quad v(w\text{–}d) - \bar{V} \geq 0,$$

with $\lambda > 0$ only when $v(w\text{–}d) = \bar{V}$.

If incomplete coverage is to occur, (12) and (14), in particular, must be satisfied. A number of implications follow (all functions evaluated at the optimal values):

i) $(\partial l/\partial p)p' + \partial l/\partial w \neq 0$ — a change in w must alter employment at the level if the firm when the price of output is adjusted so as to maintain credibility of the union's threat to unionize potential entrants. Should this condition fail — $(\partial l/\partial p)p' + \partial l/\partial w = 0$ — the union may always do better by leaving N^u and L^u unaltered, and raising w; i.e. (12) cannot be satisfied.

ii) $\partial u/\partial L^u \neq 0$ and $\partial u/\partial N^u \neq 0$. If $\partial u/\partial L^u = 0$, the union could immediately improve on the situation by raising w; i.e. (12) again cannot be satisfied. Thus $\partial u/\partial L^u \neq 0$, and (14) implies $\partial u/\partial N^u \neq 0$.

iii) $\partial u/\partial L^u$ and $\partial u/\partial N^u$ are opposite in sign. (iii) follows immediately from (14). If $\partial u/\partial N^u > 0$ and $\partial u/\partial L^u > 0$, given w and d the union may always do better simply by raising N^u and L^u by the same proportion. The opposite case, $\partial u/\partial N^u < 0$ and $\partial u/\partial L^u < 0$ yields incomplete coverage in the extreme (i.e. $N^u = L^u = 0$).

iv) $\partial u/\partial L^u$ and $[(\partial l/\partial p)p' + \partial l/\partial w]$ are opposite in sign. If both are positive for example, an increase in w, given N^u and d, raises employment in each firm and thus L^u, both effects contributing to raising the union's objective.

The union's problem ignoring (11′) can have a solution (and hence incomplete coverage exist for some commodity demand) in two situations:[12] i) $\partial u/\partial L^u > 0$, $\partial u/\partial N^u < 0$ and $[(\partial l/\partial p)p' + \partial l/\partial w] < 0$; and ii) $\partial u/\partial L^u < 0$, $\partial u/\partial N^u > 0$ and $[(\partial l/\partial p)p' + \partial l/\partial w] > 0$.

Situation 1 may be regarded as typical. Therein, the union would prefer a greater membership if it could get it without reducing w or raising N^u, and costs of union operation are such that for a given membership, the smaller the number of firms the better—resulting from fixed costs of maintaining a presence in each firm, for example. Moreover, increments to the wage, even permitting the price to rise so as to yield zero profit for unionized firms, involve reductions in the workforce employed by any firm.

More generally, a way to organize thinking about these cases is to assume the union's costs of representing workers within a given firm to consist of fixed and variable (i.e. varying with the number of workers) components. Situation (i) (resp. (ii)) is characterized by comparatively large (small) fixed costs and high (low) substitutability between labor and other factors of production.

If the union's choices of wages, dues, number of firms organized, and membership imply incomplete coverage, the independence of union actions from demand $D(p)$ is a trivial consequence. When (11′) holds as a strict inequality, N^n is merely whatever satisfies (11):

$$N^n = \frac{D[p(w)] - N^u q[p(w),w]}{q[p(w),\bar{w}]}.$$

A shift in $D(p)$, for example, simply involves an adjustment to N^n. There is no reason to change the union choice variables w, d, N^u and L^u unless the change in demand is such that even reducing N^n to $N^n = 0$ will not succeed in allowing the output of unionized firms to be sold at $p = p(w)$. Thus whenever, $N^n > 0$, a small change in $D(p)$ has no effect on w, d, N^u or L^u.

This result stands in contrast with much of the existing literature. The characteristics of product demand have figured prominently in discussions of the determination of union wages and employment since Marshall (1896). The literature dealing with union positions in regard to tariffs, government programs to stimulate various industries, etc., all assumes that union employment and wages will be affected by such measures. The above result suggests that this outcome will follow only for unions having complete coverage. Only those unions, therefore, would have an incentive to engage in lobbying activities to affect product demand, for example.

The two propositions indicated at the outset have now been established. For the monopoly union model, incomplete coverage can be a feature of equilibrium, and when it is, union choices are independent of the level of product demand.

B. Efficient Unionism[13]

How can the model be extended to encompass "efficient" unionism? It is still assumed that the union may organize whatever firm it wishes to, and determine its membership. But given the number of unionized firms and workers and the constraints implied by entry possibilities and market clearing, wages and employment per unionized firm are required to be such that the union cannot be made better off without causing firms to suffer reduced profits. The efficient outcomes may be characterized by solving the problem in the same fashion as in the monopoly case, except permitting the union to dictate $l^u \equiv L^u/N^u$ as well as w. That is, the union choice variable l^u replaces $l(p,w)$.

To proceed in this manner the union's objective need not be changed, although l^u may be included in u(·) separately if desired. The constraints (6)–(9) have to be modified in two ways. Because l^u is specified by the union, the "zero profit for unionized firms" condition ((6)) must be replaced by

$$(6') \quad \tilde{\pi}(p,w,l^u) = 0$$

where $\tilde{\pi}(p,w,l^u)$ is the maximum profit obtained by a firm when output and nonlabor factors are chosen optimally, and labor input is l^u.[14] (7a) is replaced by

$$(10') \quad L^u = N^u l^u$$

where, as indicated, l^u is a choice variable for the union.

Proceeding as above, (6′) may be solved for $p = p(w,l^u)$, and the union's problem written as the union's choosing w, d, N^u, L^u and l^u to maximize $u(w,d,N^u,L^u,\bar{w})$ subject to

$$(10') \quad L^u = N^u l^u$$

$$(8) \quad v(w\text{-}d) \geq \bar{V},$$

and

$$(15) \quad N^u q[p(w,l^u),w] + N^n q[p(w,l^u), \bar{w}] = D[p(w,l^u)].$$

The issue of the existence of incomplete coverage again turns on whether the union's problem, with (15) written

$$(15') \quad N^u q[p(w,l^u),w] \leq D[p(w,l^u)],$$

has a solution when (15′) is ignored. Substituting (10′), the Lagrangean for this problem is

$$L(w,d,N^u,L^u,l^u,\lambda) = u(w,d,N^u,N^u l^u,\bar{w}) + \lambda[v(w\text{-}d) - \bar{V}],$$

yielding first order conditions for an interior maximum:

(16) $\frac{\partial u}{\partial w} + \lambda v' = 0,$

(17) $\frac{\partial u}{\partial d} - \lambda v' = 0,$

(18) $\frac{\partial u}{\partial N^u} + \frac{\partial u}{\partial L^u} l^u = 0,$

(19) $\frac{\partial u}{\partial L^u} \cdot N^u = 0,$

and

(20) $v(w\text{-}d) - \bar{V} \geq 0.$

(16)–(20) have no solution. Even for $\lambda = 0$, $\partial u/\partial w > 0$ gives a violation of (16). In contrast to the monopoly union case, under efficient unionism an increase in the union wage has no adverse effects on union membership so long as there are some nonunion workers. Consequently the union may always improve by raising the wage unless the implied product price $p(w,l^u)$ is sufficiently high that (15′) becomes a binding constraint; i.e. the total output of unionized firms cannot be sold at $p(w,l^u)$. Under efficient unionism, union coverage is necessarily complete. An immediate consequence is that demand always plays a role in determining the union choice variables w, d, N^u and L^u.[15]

C. Testing the Independence Proposition

The tests considered in this Section concern predictions that most easily differentiate the monopoly model from others in the existing literature in addition to the efficient union model. These predictions focus on the basic result concerning the independence of union behavior and industry demand conditions in cases where union coverage is less than 100%.

The textbook monopoly models predict some non–zero response of union employment levels and wage rates in response to changes in product demand conditions. In this setting, empirical measures that divide "industries" between union and nonunion members or firms would have to be interpreted either as first aggregating over distinct industries, or as union and nonunion "types" of work in the same industry. Either way, the union–nonunion differential, for example, should somehow be sensitive to product market conditions. Similarly, union employment levels, and hence coverage, would also react to product market conditions.

In the monopoly model neither the union wage nor union employment are predicted to be sensitive to product market conditions where unionization is less than 100%. Union coverage, which is well defined in this model, is predicted to be negatively related to product market conditions because nonunion employment is positively related to product demand. Thus a test which is both crucial for the present model and which readily differentiates it from other models in the literature involves a comparison of the reaction of union wage rates and employment when product market conditions change for industries which are less than 100% unionized. In particular, finding that changes in product demand had significant effects on union wages and employment under incomplete coverage would cast serious doubt on the model. This prediction is the strongest of all because it is effectively nonparametric, in the sense that the model predicts it under all empirical parameterizations.

Moreover, this prediction is immune to standard difficulties associated with aggregation of subgroups into industries provided the subgroups are themselves less than 100% unionized; indeed, while the analysis is less informative, it is even possible to analyse empirically the case where aggregation includes some subgroups that are in fact covered fully provided some information on the aggregation is available.

The model is a long–run model, in which case the product market changes that are used for such a test should not obviously be transitory. In addition they should be separated from changes in other exogenous variables—especially the alternative wage, or union costs etc.—that would affect union behavior. Thus, an appropriate time period for the test would be one where there was general wage rate stability and where major modifications in trade union legislation were absent. Under these conditions a finding of sensitivity of union variables to product market conditions in the less than full coverage case would be major evidence against the model proposed in this paper. Further evidence against this model, along with many others, would be provided by evidence that union wages and employment were insensitive to product demand changes under complete coverage.

To summarize, in this Section a general model of the interaction among a union, firms, workers and consumers was developed. Assuming that the union could control wages, but not dictate employment, it was demonstrated that under some circumstances—principally that wage increases had undesirable effects on membership—the equilibrium will entail incomplete union coverage, depending on product demand. Moreover, when incomplete coverage holds, union actions are independent of product demand. Subsequently, the model was altered to generate efficient unionism. Under this specification, incomplete coverage could never occur and union actions would necessarily be influenced by product demand. The features of an appropriate test of the independence of union wages and employment from demand under incomplete coverage were described.

II. A SPECIFIC MODEL AND ITS IMPLICATIONS

The general model analyzed in Section I provided some strong implications which should be regarded as that framework's key hypotheses. In this Section much more structure is imposed and a broader variety of implications thereby obtained.

A severe shortage of specific implications has long been an obstacle to distinguishing among existing theories of unionism and developing more realistic and informative models. While the specific cause of this problem is not yet known with certainty, there is evidence that the conventional assumption of complete coverage is the culprit. In the authors' earlier study (1986) it was shown that the simple and clear results to follow (obtained under incomplete coverage) generally will not hold under complete coverage. Also, Lazear (1983), using a more complicated model, succeeds in providing some unambiguous results under incomplete coverage and free entry. Thus, in this Section attention is restricted to situations involving incomplete coverage. Given the general result in Section I, the model analyzed in this Section must therefore be of the monopoly unionism variety.

The analysis proceeds as follows. First, the additional structure is imposed, and comparative statics–type predictions provided. It is then shown that the restricted model can be enriched in a number of directions so as to address a broader set of union issues and aid in the interpretation of existing empirical results.

A. More Structure

Two additional restrictions are imposed.

First, it is assumed that labor is the only variable factor of production. Under this assumption it is easily shown that[16]

$$\text{(21)} \qquad \frac{\partial l[p(w),w]}{\partial p} p' + \frac{\partial l[p(w),w]}{\partial w} < 0,$$

and

$$\text{(22)} \qquad \frac{\partial q[p(w),w]}{\partial p} p' + \frac{\partial q[p(w),w]}{\partial w} < 0$$

Recall, from the discussion in Section I, that under (21), incomplete coverage requires that $\partial u/\partial L^u > 0$ and $\partial u/\partial N^u < 0$ hold at equilibrium values.

Second, the union's objective function is restricted to the form

$$\text{(23)} \qquad u(w,d,N^u,L^u,\bar{w}) = dL^u - c(N^u, L^u),$$

where $c(\cdot)$ is a monotonically increasing and strictly convex cost function. $c(\cdot)$ is assumed twice continuously differentiable with (subscripts denoting partial derivatives):

$$\text{(24)} \qquad N^u c_{12} + L^u c_{22} < 0.$$

(24) is a checkable sufficient (and not necessary) condition for the results to follow, and is imposed merely to simplify the discussion. To interpret (23), note that it is equivalent to

$$\text{(25)} \qquad \frac{d}{dN^u} c_2(N^u, N^u l^u) < 0,$$

for $l^u \equiv L^u/N^u$ workers being employed in each unionized firm. (25) states that the marginal cost of raising L^u is lower when the income can be spread over more firms.[17]

In the form (23), the model can be regarded as a formalization of the conception of unions offered by Berkowitz (1954, p. 576): "The union is thought of as an enterprise with an institutional life of its own, separate and apart from any of its members. It may be characteristically controlled and responsive to the will of the dues–payers, yet it is a separate entity. It has its own survival needs, among which, it is argued, is the necessity to be aware of some sort of economic calculus."[18]

There are many other specializations of $u(\cdot)$ that might be employed to generate more results; (23), however, is a form that allows a particularly straightforward discussion of a wide range of issues. The consequences of assuming other union objectives may be obtained in a similar fashion.

B. More Predictions Under Incomplete Coverage

Given (23), the union's problem may be written: choose w, d, N^u and L^u to

$$\max dL^u - c(N^u, L^u)$$

subject to

$$L^u = N^u l[p(w), w], \tag{10}$$

$$v(w-d) \geq \bar{V}, \tag{8}$$

and

$$N^u q[p(w), w] \leq D[p(w)]. \tag{11'}$$

Observe that so long as (8) does not hold with equality the union's objective can be augmented by raising d. Thus (8) must hold with equality, implying $d = w - \bar{w}$, which may be substituted into $u(\ )$. Similarly, $N^u l(\cdot)$ replaces L^u. Define $l(w) \equiv l[p(w), w]$, with $l' < 0$. Then the union's problem is to choose w and N^u to

$$\max (w-\bar{w})N^u l(w) - c[N^u, N^u l(w)] \tag{26}$$

subject to

$$N^u q[p(w),w] \leq D[p(w),w],$$

First order necessary conditions characterising an interior maximum with incomplete coverage are

(27) $N^u l(w) + (w-\bar{w})N^u l' - c_2 N^u l' = 0$

and

(28) $(w-\bar{w})l(w) - c_1 - c_2 l = 0.$

As usual, second order conditions require the matrix of second derivatives of (26) with respect to w and N^u to be negative semi definite in a neighborhood of the maximum.[19]

Turning to the predictions, first consider changes in the demand for the product. Since $D(p)$ does not appear in the union's problem, neither w nor N^u depends on it, from which it follows immediately that $p(w)$ does not vary either. Accordingly, all changes in $D(\cdot)$ are fully captured by the increment to $D(p)$ for $p = p(w)$, and the sole response is in terms of entry or exit of nonunion firms.

The impact of a variety of parameter changes can be considered quite straightforwardly. To economize on space, only the impact of a change in workers' alternatives will be presented in detail.[20]

Workers have an alternative yielding utility $\bar{V}$. Since $v(\bar{w}) = \bar{V}$, $d\bar{V} > 0$ translates into $d\bar{w} > 0$. Application of the usual calculus to (27) and (28) yields:

$$\frac{dw}{d\bar{w}} > 0 \text{ and } \frac{dN^u}{d\bar{w}} < 0.$$

Thus, a rise in the value of alternative opportunities generates an increase in the union wage and a decline in the number of union firms. The intuition is just that the initial rise in $\bar{w}$ operates like a factor price increase for the union, which therefore responds by scaling back operations directly, via reducing N^u, and indirectly through the reduction in L^u induced by raising w.

The basic results $dw/d\bar{w} > 0$ and $dN^u/d\bar{w} < 0$ immediately imply a variety of results about other attributes of the union portion of the industry. First, consider the union–nonunion wage differential $\delta \equiv w - \bar{w}$. A tedious derivation indicates that δ will rise with an increment to $\bar{w}$ unless the increase in w generates a sharp absolute increase in elasticity of $l(w)$. The leading case is clearly $d\delta/d\bar{w} > 0$. This result again offers sharp contrast with the usual monopoly union model, which has inherently ambiguous predictions regarding the union–nonunion wage differential.

Second, at the level of the firm both employment of union workers and output of unionized firms declines with an increase in $\bar{w}$

$$\frac{dl}{d\bar{w}} < 0 \text{ and } \frac{d}{d\bar{w}}\, q[p(w),w] < 0.$$

The first change is a direct result of $dw/d\bar{w} > 0$, and the second follows immediately from the employment change.

Third, union membership and the total output of unionized firms declines:

$$\frac{d}{d\bar{w}}\,[N^u l(w)] = N^u l' \frac{dw}{d\bar{w}} + l\,\frac{dN^u}{d\bar{w}} < 0$$

and

$$\frac{d}{d\bar{w}}\,\{N^u q[p(w),w]\} = N^u \frac{dq}{d\bar{w}} + q[p(w),w]\,\frac{dN^u}{d\bar{w}} < 0.$$

Fourth, since (26) implies l must be elastic, total payments to unionized labor must also decline—

$$\frac{d}{d\bar{w}}\,[wN^u l(w)] = N^u\{\frac{d}{dw}\,[wl(w)]\}\,\frac{dw}{d\bar{w}} + wl(w)\,\frac{dN^u}{d\bar{w}} < 0$$

—as does labor's share in unionized firms:

$$\frac{d}{d\bar{w}}\left\{\frac{w\ell(w)}{F+wl(w)}\right\} \propto \left\{\frac{1}{wl(w)} - \frac{1}{F+wl(w)}\right\}\frac{d}{d\bar{w}}[wl(w)] < 0,$$

where F represents the (fixed) cost of all other inputs for the firm.

Two final predictions for changes in $\bar{w}$ concern union "profits" and the equilibrium product price. First, the envelope theorem implies the amount of resources agents might be willing to expend to acquire the union monopoly position, or organize workers, declines as $\bar{w}$ rises. Second, $dw/d\bar{w} > 0$ implies an increase in the level of minimum average cost, and hence

$$\frac{dp(w)}{d\bar{w}} > 0$$

where $p(w)$ is the equilibrium price of the product. It is nevertheless true that although p rises, both the revenue of each unionized firm (pq) and the revenue of the union sector ($N^u pq$) fall when $\bar{w}$ rises. Such must occur simply because factor payments ($F+wl$) and $N^u[F+wl]$ fall and union firms must earn zero profits.

The above results constitute unambiguous predictions in response to changes in $\bar{w}$ for a variety of aspects of union behavior, at both the individual union firm and aggregate union sector levels. An additional feature of interest in the union literature, however, is the extent of union organization in the industry as measured by the fraction of total employment which is unionized. In order to consider this entity, predictions on the nonunion component of the industry are required.[21] Consider first, the aggregate behavior of nonunion firms. Recall that these firms simply fill in the difference between total union output and quantity demanded at the equilibrium price. When $\bar{w}$ rises, total union output falls; however the equilibrium price rises so that total quantity demanded also declines. Consequently, for a given reduction in union output, the change in nonunion output depends on the price elasticity of demand for the product. When product demand is not too elastic, for example, the impact of changes in $\bar{w}$ on union employment, $N^u l(w)$, translates into a change of the same sign in the fraction unionized: $N^u l(w)/\{N^u l(w) + N^u l[p(w),\bar{w}]\}$.

C. Enrichments and Further Discussion

The restricted model is easy to manipulate and generates a variety of predictions. However, the setting assumed was deliberately made sparce to highlight the results under incomplete coverage. Given a richer setting there are numerous other issues on which the model can shed light. In this section some of these elaborations are explored. Further, some discussion on whether the model assists in understanding existing empirical work is called for. Finally, it is shown that at some cost, the model's predictions can be stated in other ways, and that doing so may yield a return in terms of reduced informational requirements for testing.

1. A More Active Role for the Union

In the specialized model presented in Section II, the union was viewed purely as a dues collection agent, a la Berkowitz. This treatment provided very clean analysis, but is less than adequate for several reasons. One is that the intraindustry union–nonunion wage differential is predicted to equal the dues ($w - \bar{w} = d$) and comparison of standard industry level estimates of the differential ($\delta/\bar{w} \approx .01$) would reject that hypothesis readily. Second, unionized firms seem to organize work differently, and in a fashion which is not obviously explicable as a simple response to higher wages (see the data in Duncan and Stafford (1980) for example).

The point of this subsection is to show that the analysis is easily augmented to allow unions a role in the structure of production. The extension can be made more complicated, and presumably a study focusing on this issue would do so, but the route taken here suffices to make the point.

Assume, as above, that output is produced using a single variable input l: $q = f(l)$ with $f' > 0$ and $f'' < \varepsilon$ ($\varepsilon < 0$) for all l. Any firm's total cost, given some wage $\hat{w}$, is

$$F + \hat{w}h(q)$$

where $h(q) \equiv f^{-1}(q)$ and F is again the cost of fixed factors.

Suppose the union provides firms with services converting l units of labor input into γl units, $\gamma \neq 1$—possibly at a cost of raising F by the factor $\phi > 1$—and in so doing generates services to union workers which they value at s. (Here γ, ϕ and s are taken as exogenous, but they need not be). The monitoring type activities making large assembly lines efficient that are frequently discussed (again see Duncan and Stafford) can be treated by specifying $\gamma > 1$, $\phi > 1$ and $s < 0$. On the other hand, $\gamma < 1$, $\phi = 1$ and $s > 0$ may represent the on–the–job social aspect of union membership. In either case, the union is thought of as the agent who internalizes external economies which prevent individual firms from offering these services on their own.

Proceeding in this fashion, the modifications required in the above analysis are simply the replacement of $w - d = \bar{w}$ with

$$w + s - d = \bar{w},$$

and the union firm's cost function by

$$F + (w/\gamma)h(Q).$$

The union's problem is then equivalent to choosing w and N^u to [22]

$$\max\ (w+s-\bar{w})N^u l[p(w),w,\gamma] - c\{N^u, N^u l[p(w),w,\gamma];\gamma,s\}$$

subject to $N^u q[p(w,\gamma),w,\gamma] \leq D[p(w,\gamma)]$,

where $l[p(w),w,\gamma]$, $q[p(w),w,\gamma]$ and $p(w,\gamma)$ are analogous to $l[p(w),w]$,$q[p(w),w]$ and $p(w)$ defined above, and $c(\,)$ now includes the cost of providing the (γ,s) package to l workers at each of N^u locations.

This richer structure allows considerations of a new set of issues; for example, the influence of the union on labor productivity, and relative profitability and size of union and nonunion firms. There is little theoretical work that provides a framework within which to generate predictions on union and firm (or plant) sizes. Parsley's (1980) survey of the empirical work links discussion of firm size primarily to its relation with the degree of concentration in product markets. Lazear's (1983) model does not have an explicit prediction for the size of union versus nonunion firms. (In that setting this comparison would depend on the sign of the correlation between entrepreneurial abilities that lead to a large firm size with the abilities to resist unionization. If these were positively correlated, for example, nonunion firms would also be relatively large.) In the present model, the relative size of union and nonunion firms could be parameterized in terms of union–nonunion differences γ and ϕ. If the productivity effects of unions do operate by making large scale production line processes efficient through solving monitoring problems, such could be captured by $\gamma > 1$ and $\phi > 1$, as indicated earlier. The size difference across firms will then depend on the relative magnitude of γ and ϕ, and hence the capital intensity of union versus nonunion firms. The larger is ϕ, the more likely it is that union firms will be larger than nonunion firms. The implications for firm size differences and the wage differential would then follow from an analysis of the effects of changes in γ and ϕ, analogous to that presented above.

The "productivity and profitability issue" can also be considered. An influential area of recent empirical analyses of unionism has been the "Harvard School" productivity studies. (See Freeman and Medoff, 1979, 1984 (Ch. 11); Clark, 1980 and also Vaas and Mishel (1986)). The implications of the findings in some of these studies for firm profits in the unionized sector have also generated discussion of the seemingly paradoxical result that lower costs under unionism are associated with lower firm profits. (Freeman and Medoff, 1984; Ruback and Zimmerman, 1984). The hypothesis that unions contribute positively to the production process implies $\gamma > 1$. Imposing this restriction, the relationship between profits and productivity across union and nonunion sectors is readily examined in the present model. Ruback and Zimmerman (1984) provide some evidence that unionization lowers equity value. Freeman and Medoff (1984, TAble 12.1) also conclude that unions reduce profitability of the unionized firms. This outcome is always implied by the model since a hitherto nonunion firm in the industry is making positive profits. Any change that causes the union to unionize a larger fraction of the existing firms in the industry (say, a reduction in union marginal costs) will imply lower profits for these firms. The traditional monopoly union model in which a union takes over a competitive industry would predict no change in the profit levels of on–going firms before and after unionization since all would be making zero profits in both situations. Both Freeman and Medoff (1984) and Ruback and Zimmerman (1984) refer to casual evidence that operating firms always resist unions. This would not be a prediction of the traditional monopoly model since the firm knows it will be unionized, and thus it would not pay to use resources in a vain attempt to prevent this. On the other hand, in the present model, firms operating in an industry in which unionization is increasing will have an incentive to resist unionization since there will, in equilibrium, be nonunion firms making positive profits. It will in general pay to improve the firm's chance of being one of these nonunion firms. A related prediction is that the profitability of a firm entering the industry and being unionized (N^u increasing) should not be greatly affected by this change.

Lazear (1983) presents an explicit analysis of firms spending resources to prevent their becoming unionized; see also Kuhn (1985). Because of the complexity of Lazear's model, the amount spent to combat unionism was considered exogenous. In particular, no attempt was made to relate this to the size of the wage differential. In the simpler model of the present section, the amount of resources spent—and more particularly its relationship to other variables in the model—can readily be derived. All that is required is a mechanism for the allocation of firms to the nonunion sector based on resources spent. The basic analysis does not change in any important way provided these resources would not be captured by the union.

2. Strikes

The model analyzed above does not admit the possibility of strikes. The setting is one of complete information, and incomplete information appears to be a prerequisite for strikes to emerge as equilibrium outcomes outside of repeated environments.

An incomplete information environment in which strikes may be analyzed is as follows. Suppose that having decided to enter an industry, each firm learns the value of a firm–specific cost parameter—a location advantage, for example—the knowlege of which is private information. Assume further that the union chooses a collection of firms to unionize, as above. Having done so it is to the union's advantage to attempt to learn the firm's private information. A strike can be used to pursue this end. Specifically, equilibrium can involve the union offering two wage rates, w_1 and w_2; $w_1 > w_2$. Union firms can choose to pay w_2, but only by inducing a strike of length τ. The triple (w_1,w_2,τ) can be chosen along with N^u to maximize union profits subject to the strike length–wage combination yielding truthful revelation of cost parameters by firms, in Revelation Principle style.

Proceeding in this fashion, union wages, number of union firms and strike length are all endogenous and jointly determined. Predictions regarding the response of each to changes in the economic environment may be obtained.[23]

3. Union Effects on Skill Accumulation

That the presence of unions might alter the worker's training choice in various ways has been pointed out in a series of recent papers; see, for example, Weiss (1985) and the references therein. Though the model used here is not a dynamic one, it can still prove to be a useful framework for addressing the type of questions raised in those papers. One example will suffice. The model set out above treats the union as in some way interacting with l workers at each of N^u locations. It is not hard to construct a situation in which, unless dealing with skilled workers renders this process much less costly, the union finds the possibility that union firms will seek to substitute towards more skilled (though still unionized) workers a binding constraint on its behavior. Much like a product market monopolist, the union would prefer not to see a decrease in demand for its product. Here the product is "bodies", and the decline in demand comes via substitution of skill for bodies. In such a situation, the possibility that workers' skill might be augmented generally causes the union to lower union wages and raise the number of union firms.

4. Unconditional Predictions, and the Interpretation of Some Existing Empirical Work

The set of predictions derived above can be stated in several different ways. Pursuing the alternative representations is usually not costless, but may reduce the information required to test the model.

To proceed, not that the conventional route of defining

$w = \omega(\bar{w}, F, \ldots)$,

$N = \eta(\bar{w}, F, \ldots)$,

.

.

.

and $p = \rho(\bar{w}, F, \ldots)$,

has been followed. These equations represent the reduced form of the model, and its predictions are in terms of the partial derivatives of $\omega(\cdot)$, $\eta(\cdot)$, etc. These predictions can be stated in an alternative form because all exogenous variables in the model influence w and N^u in opposite directions. This result occurs because all changes ultimately yield a change of "scale" for the union, generating N^u and L^u moving in the same direction (as a result of w changing in the opposite fashion.[24] From this result it might be tempting to assert that the unconditional covariance of w and N^u (where the variation in w and N^u is induced by variations in underlying exogenous variables) is negative. In general this statement is correct if (but not only if) the exogenous parameters are determined independently of one another. Given this restriction, which represents the cost of reducing informational demands, $Cov(w, N^u) < 0$ is implied. Moreover, since the results on δ, q, l, $N^u l$, $N^u q$, $wN^u l$, and p are obtained from the changes in w and N^u, the theory has implications for most unconditional correlations between arbitrary pairs of these variables or correlations conditioned on a subset of exogenous variable.

Viewing the predictions this way is useful for interpretation of existing empirical results. For example, that $Cov[w, wl/(wl+F)] < 0$ is predicted provides an explanation for the result (see, for example, Rosen (1970)) that union labor and other factors appear to be good substitutes; that is, Cov[ ] < 0 is usually interpreted as evidence of a substitution elasticity in excess of unity.

A second example is that the standard Lewis (1963) approach to estimation of average industry union–nonunion wage differentials can be given an interpretation in terms of underlying parameters. Letting w^{α} equal the industry average wage rate and μ the fraction unionized,

$$ln w^{\alpha} \approx ln \bar{w} + \mu \; ln(w/\bar{w})$$

assuming the geometric average approximates the arithmetic average satisfactorily. Then using

$$ln(w/\bar{w}) = ln\ 1 + (\frac{w - \bar{w}}{\bar{w}}) \cong \xi,$$

where ξ is the percentage union–nonunion differential.

$$ln\ w^{\alpha} \cong ln\ \bar{w} + \mu\xi.$$

The theory presented above implies that ξ should vary with exogenous features of the industry (which it seems to; see for example MacDonald and Evans (1981) and MacDonald (1983)), and that given ξ (i.e. holding all exogenous factors relevant to ξ fixed), the coefficient of μ in an estimated version of the above equation should yield an estimate of ξ. This property holds because for constant ξ, variation in μ and $ln\ w^{a}$ is induced by movement in $D(p)$.

A final example concerns observed wage and price rigidities. The theory presented in this paper is one of a partial equilibrium. Thus it is not, in its present form, appropriate for discussion of macroeconomic issues. However, individual industry evidence of wage rigidity is often alluded to in macro discussions of unemployment (e.g., Taylor, 1983). There are also micro studies of wage rigidities stemming from union behavior (e.g., Grossman, 1984); also see McDonald and Solow, (1982). Apparent wage and price rigidities follow from the product market independence results of the present model in cases where unions have less than 100%

coverage. Perhaps ironically, it is the "weaker" unions, in the sense of generating less than full coverage, that yield the wage rigidities.

III. CONCLUSION

What is this paper's contribution? It shows that it is possible to construct a theory of unionism that is not fundamentally different from other existing models, but that is both easy to manipulate and extend, and restricts the data substantially. It is therefore possible to subject the model to test relatively easily, and to address a broad menu of issues within a single simple framework.

The fundamental feature of the model for empirical purposes is the characterization of different situations that lead to complete union coverage and substantially different predictions that occur for union behavior in complete vs incomplete coverage situations. The model permits "monopoly" and "efficient" union models to be distinguished on the basis of very little data. In particular incomplete coverage implies that the efficient union model is not generating the data. Careful measurement of coverage may in fact show situations of both complete and incomplete coverage in different industries. The model employed in this paper would then predict that union behavior in these industries would differ in systematic ways. For example, evidence for an efficient union model (i.e. bargains not located on firms' demand curves) should only occur in complete coverage industries.

Finally, the paper has been exclusively concerned with union interaction with competitive firms. For incomplete coverage to occur in the model, the union had to have the power credibly to threaten potential firms with union status. Analysis of this situation is most straightforward when firms are "small". For some markets this may be an inappropriate assumption. An alternative bargaining model where firms have more bargaining power than their competition nature gives them in the present context may be more appropriate in some circumstanes. As usual it is difficult to tell a priori whether "competitive firms" is a useful abstraction for a given market. It does, however, provide substantial prediction power. The testing of these predictions is one way to make more headway on the important and illusive topic of union behavior.

Footnotes

[1]For a general survey, see Farber (1986).

[2]One set of circumstances that may yield incomplete coverage is as follows. In addition to always preferring higher wages (all else constant) (i) the union views increased membership as attractive for any given number of unionized firms; but (ii) as a result of costs of organization, the union is made worse off if a given membership must be spread across a larger number of unionized firms.

[3]See MacDonald and Solow (1982), Oswald (1982, 84), MaCurdy and Pencavel (1986) and Brown and Ashenfelter (1986).

[4]Obviously union effects on productivity are suppressed in this discussion. The argument extends to that situation easily.

[5]Depending on the union's objective, it may turn out that in equilibrium, union and nonunion workers obtain equal utility in which case limiting membership is not required.

[6]It should be noted that the assumption regarding the role of the union does not imply the analysis is only applicable to a "closed shop" setting. Indeed, members of the union are merely workers who are paid the union wage and pay union dues. "Union shop" or "agency shop" interpretations are thus not excluded.

[7]These latter restrictions merely serve to eliminate perverse theoretical possibilities, e.g. that the union's optimization problem has no solution.

[8]The prices of other factors of production would normally appear in $\pi(\cdot)$. To avoid complicating the notation unduly, these prices are suppressed.

[9]With some restructing, the model may be recast with, for example, union firms receiving some rents. This outcome is supported by the union threatening potential firms with nonunion status, and making transfers of some (not necessarily monetary) variety to union firms. Nothing of consequence about union wages, employment, etc. seems to depend on the

exact structure utilized here, although some features on nonunion behavior may. The key feature is that the union must be able to guarantee that any firm that might plan to enter and somehow obtain part of the rents generated by the union, would actually find no benefit in doing so.

[10](7a) can be replaced by $L^u \geq N^u l(\cdot)$. The additional complication introduced by doing so is that some method of allocating unionized workers to employed and unemployed status, (as well as compensating the latter, if necessary, to satisfy an expression analogous to (8)), must be specified.

[11]Under the assumptions made above, the constraint set defined by (10), (8) and (11) is not empty if, for example, the industry would have an equilibrium with positive industry output under competition; i.e. that the price at which $D(p) = 0, \bar{p}$, satisfies $\bar{p} > p(\bar{w})$. It can also be checked that this feasible set is compact. Thus provided u( ) is continuous, as will be assumed, the problem is well posed and has a solution.

[12]Conditions (i)–(iv) are obviously necessary, but not sufficient, for incomplete coverage.

[13]Efficient unionism has not, so far as the authors are aware, been studied in a market situation allowing many unionized firms, potential entry, etc. In the material to follow, every attempt has been made to remain faithful to the spirit of the efficient union literature.

[14]$\tilde{\pi}(p,w,l^u) = \pi(p,w)$ when l^u is such that $\partial\tilde{\pi}/\partial w = -l^u$.

[15]It is certainly possible to modify the model so as to allow incomplete coverage under efficient unionism. Deleting $\partial u/\partial w > 0$ would do. However, the point here is that unless some factor is introduced explicitly to impose incomplete coverage, the efficient union model will rule it out.

[16]See the authors (1986).

[17]In conjunction with (24), convexity of c( ) yields

$$L^u c_{12} + N^u c_{11} > 0, \text{ or } \frac{d}{dN^u} c_1(N^u, N^u l^u) > 0.$$

[18]Also see Dunlop (1950) and Lentz (1984).

[19]Observe that given w, L^u and d, $\partial u/\partial N^u < 0$ always holds, in which case $\partial u/\partial L^u > 0$ is needed for incomplete coverage. Now given w, N^u and d

$$\frac{\partial u}{\partial L^u} = d - c_2.$$

(27) implies

$$(d - c_2)l' = -l$$

or

$$d - c_2 = -\frac{l}{l'} > 0,$$

implying $\partial u/\partial L^u > 0$.

[20]For more comparative statics, see the authors (1985).

[21]It should be reiterated that the precise nature of predictions about nonunion behavior is maybe sensitive to details of the specification studied herein. Recall note 9.

[22]Implicit here is the restriction that although $\gamma > 1$ could obtain, in equilibrium union firms remain at a cost disadvantage. If this relation fails, the model can still be analyzed, but the nonunion firms earn zero profits, union firms earn non–negative profits, and the union threatens potential entrants with <u>non</u>union status. If the union–nonunion production difference was purely in terms of γ (ϕ=1), the restriction implies $w/\gamma > \bar{w}$ at the optimum. More generally, if $\gamma \neq 1$ also implies $\phi \neq 1$, $w/\gamma > \bar{w}$ is not required.

[23]This material precises MacDonald et. al. (1986).

[24]See the authors, (1986).

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