MARKET POWER AND PRICE: THEORY AND EVIDENCE ON LABOR UNIONS

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INTRODUCTION

Economists have long been concerned with the effects of market power on price. This paper analyzes the market power and pricing of labor unions. We consider how the union's ability to increase its "price" — the compensation of union workers — changes with the percent of an industry's firms that are unionized. This is analyzed both theoretically and empirically.

Many studies show that union wages are higher in heavily unionized industries, consistent with the idea that as market power increases, sellers charge higher prices. However, a problem arises in interpreting the magnitude of the effect: greater union organization may not "cause" the higher wages but it may be that more unionization occurs where unions can extract higher wages. We account for this reverse causality by treating both the union wage and extent of union organization as choice variables of the union.[1]

This makes the study unique in the literature. Also unique is that we model the union in a competitive product market with unrestricted entry. The outcome is an equilibrium mix of union and nonunion firms. Based on our model, we test for and reject the exogeneity of union organization. Further, we correctly predict the bias of OLS estimates of the effect of union organization on the union wage and provide consistent estimates.

Many have argued that the union's market power increases with the extent of union organization in an industry by reducing the elasticity of demand for union labor [Rosen, 1969; Freeman and Medoff, 1981; Lewis, 1986]. Many studies have found a positive effect of union organization on union wages by regressing union wages on the percent of the industry's workers organized (a proxy for union organization) [Freeman and Medoff, 1981; Holzer, 1982; Hirsch and Neufeld, 1987; Hundley, 1987; Curme and MacPherson, 1991; Belman and Voos, 1993]. However, treating union organization as an explanatory variable implicitly assumes that the extent of union organization is exogenous to the industry. This seems inappropriate. Voos finds that, "Several (union) officers stated in interviews... that their union is in a stronger negotiating position when it has organized the competitors of the firm at the bargain-

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ing table, and that is their major economic reason for organizing" [1983, 578]. In this paper, we model the size of the union at the industry level as a choice variable for the union.

Lee [1978], Farber [1983], and Robinson [1989] treat the joint determination of union status and union wages, but examine the individual's choice of union status. In contrast, we examine the union's choice of how many firms to organize. This choice is subject to various constraints, including the ease of generating support for the union among workers, the legal environment that may aid or impede this effort, and employer resistance.

While most of the literature does not model this aspect of unions, exceptions are Lazear [1983], Abowd and Farber [1990], and MacDonald and Robinson [1992]. Lazear assumes that product demand is perfectly elastic so union effects on the product market are ignored. MacDonald and Robinson arbitrarily assume that the union is able to restrict entry into the partially unionized industry. Abowd and Farber consider the union's choice of optimal organization in an imperfectly competitive industry with quasi-rents. Lazear and Abowd and Farber also model employer resistance to unions.

While we incorporate employer resistance by allowing it to affect union organization costs, our model is unique in that it considers equilibrium unionization in a setting where union behavior affects the product market and there need be no entry restrictions. We incorporate the insight of Kuhn [1988] that firms are heterogeneous. If unions organize the more efficient firms, union firms can survive in competition with nonunion firms. The equilibrium coexistence of union and nonunion firms with free entry is a unique aspect of our model and adds to the attractiveness of our approach.

The next section of the paper presents our model. We examine how the union establishes wage and organization policies given their effects on the product market equilibrium. We predict that OLS overestimates the extent to which increases in union organization enables the union to obtain wage gains. The reason is simple: exogenous factors that work to increase the union wage are positively related to the extent of organization, resulting in too much of the wage effect being attributed to increases in organization.

The empirical section uses two-stage least squares to provide consistent estimates of the effect of union organization on union wages. The data are the 1988 Current Population Survey. Endogeneity tests reject the exogeneity of union organization. As predicted, OLS estimates are positively biased by over 25 percent.

THE MODEL

The Product Market

Product market effects are key in enabling unions to gain more market power by increased organization in an industry.[2] Unionized firms, when faced with higher wages, reduce employment and output. If the percent of the industry organized is large, nonunion firms cannot make up for the reduction in output of the unionized firms, allowing output price to rise substantially.[3] The higher price induces a smaller

disemployment effect on union firms and implies a lower elasticity of demand for union labor.

Formally, let the firms in an industry produce output according to the production function $f(L,\alpha)$, where L is labor input and α is an index of the ability or efficiency of the owner/manager of the firm.[4] Assume that α is distributed on the interval $[0,T]$ with density $g(\alpha)$, with f_L and f_α positive and $f_{L\alpha}$ positive. Firm heterogeneity is introduced by variation in α.[5]

Firm heterogeneity is important in a model of union organization. Because union firms pay higher wages, to survive they must be "better." In our model, this means that union firms must be disproportionately from the upper tail of the distribution of α.

Profit for each firm is $\Pi = pf(L,\alpha) - w^i L$ where $i = u,n$ for union and and nonunion firms, p is product price, and w is the wage. Managers have opportunity cost V of operating a firm.[6] The rent for operating a firm is $\Pi - V$. To operate a firm, this must be non-negative. If entry barriers exist, then $\Pi - V - C$ must be non-negative, where C is the cost of entry.

In a nonunion setting, the marginal talent level, α^*, is the level that solves $pf(L,\alpha^*) - w^n L = V$ (if C = 0). Those with $\alpha > \alpha^*$ operate firms and others do not. For unionized firms to survive, they must be disproportionately from the upper tail of the distribution of α. For simplicity, assume that unions organize all firms with $\alpha > \alpha^u$, where $\alpha^u > \alpha^*$. A lower α^u means more firms closer to the margin are organized and union organization rises.

Profit maximization defines the firm labor demand curves, $L^i = L(w^i, p, \alpha), i = u, n$, and supply curves, $q(w^u, p, \alpha)$ for $\alpha \geq \alpha^u$ and $q(w^n, p, \alpha)$ for $\alpha^u > \alpha \geq \alpha^*$. Industry supply is

$$Q(w^u, w^n, p, \alpha^u, \alpha*) = \int_{\alpha^u}^{T} q^u(w^u, p, \alpha)\, g(\alpha) d\alpha + \int_{\alpha*}^{\alpha^u} q^n(w^n, p, \alpha)\, g(\alpha) d\alpha.$$

Let industry product demand be given by D(A,p), where A is such that an increase in A causes the demand elasticity to rise (in absolute value). Equilibrium in the product market requires demand equals supply, or

$$D(A, P) = \int_{\alpha^u}^{T} q^u(w^u, p, \alpha)\, g(\alpha) d\alpha + \int_{\alpha*}^{\alpha^u} q^n(w^n, p, \alpha)\, g(\alpha) d\alpha.$$

Product price is determined by this equation.[7,8]

Differentiating this equation, it is straightforward to show that the product price rises in the union wage and falls in α^u. Also, product price is higher the greater is the entry cost, C. Consider the elasticity of product price with respect to the union wage, η_{pw^u} If the production function f(·) is homogeneous of degree $r < 1$,[9] then

$$\eta_{pw^u} = \{[-r/1-r)]S^u\}/\{E_D - [r/(1-r)] + s^n(\alpha^*)g(\alpha^*)\alpha^*\epsilon_{\alpha^* p}\} > 0,$$

where $E^D < 0$ is the elasticity of product demand with respect to price, $\epsilon_{\alpha^* p} < 0$ is the elasticity of the marginal talent level with respect to price, S^u is the union sector's

share of total market output, and $s^n(\alpha^*)$ is the share of market output of the marginal (nonunion) firm.

Reducing α^u (increasing coverage) raises S^u and η_{pw^u}. A union wage hike has a larger effect on price the greater is union coverage. Increasing (in absolute value) in the elasticity of product demand, E_D, reduces η_{pw^u}. The more elastic is product demand the smaller the effect of a union wage increase on product price.

Differentiating total union employment, L_T^u, with respect to w^u and and expressing in elasticity form yields

$$\eta_{L^u w^u} = [1/(1-r)]\,(\eta_{pw^u} - 1) < 0.$$

Two effects are seen from this equation. An increase in the (absolute value of) the elasticity of product demand reduces η_{pw^u} and makes the demand for union labor more elastic. Also, an increase in union coverage (a decline in α^u) causes η_{pw^u} to rise, making $\eta_{L^u w^u}$ closer to zero, or less elastic. Thus, increased coverage reduces the elasticity of demand for union labor.

This is consistent with the usual thinking on this issue. Note that our model shows this holds in a setting with product market equilibrium, even if entry is unrestricted. Also, the equilibrium is one where union and nonunion firms coexist. This is absent in models of unionism in the literature.

The Behavior of Monopoly Unions

We assume that the union's goal is to maximize a function increasing in union wages and employment (a "utility" function), less the costs of organization, subject to firms' labor demand curves.

Let the cost function for organizing and administering the union be $\Phi(L_T^*,\phi)$, with $\Phi_L > 0$, $\Phi_\phi > 0$, $\Phi_{L\phi} > 0$, where L_T^* is total employment at unionized establishments prior to unionization.[10] The term ϕ represents union organizing cost shifters, such as the costs of organizing geographically disperse workers, the legal environment, and employer resistance to the union.

The union chooses w^u and α^u to maximize

$$\Theta = U(w^u, L_T^u) - \Phi(L_T^*, \phi).$$

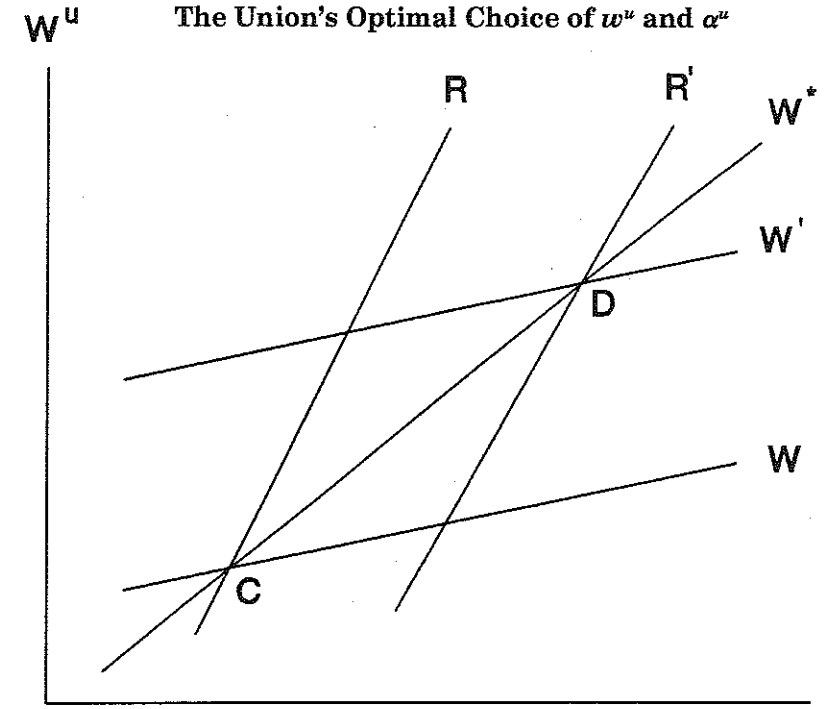
The first order conditions are

$$(1) \qquad \Theta_{w^u} = U_w + (L_T^u, U_L/w^u)\,\eta_{L_w^u w^u} = 0\,.$$

$$(2) \qquad \Theta_{w^u} = U_L[-L^u(w^u, p, \alpha^u)g(\alpha^u) + (\partial L_T^u/\partial\alpha^u)] + \Phi_L L_T^* g(\alpha^u) = 0.$$

The first term in equation (1) is the union's marginal benefit from a higher wage. The second term is the marginal cost from the employment loss suffered.[11] Equation (2) shows similar aspects for coverage. The terms in brackets show the marginal benefits from increasing coverage (reducing α^u). The last term represents the marginal cost of a decrease in α^u.

FIGURE 1
The Union's Optimal Choice of w^u and α^u



Using equations (1) and (2), consider the effects on the union's policies of changes in the costs of organization and the elasticity of product demand.[12] Let ϕ shift to raise marginal organization costs. This reduces the extent of coverage (α^u increases). Lower coverage raises the elasticity of demand for union labor. From (1), this induces the union to lower the wage. Thus, coverage and the union wage move together. Also, greater entry barriers (a higher C) keeps price and employment higher, raising the extent of coverage.

An increase in the absolute value of product demand elasticity, E_D, raises the absolute size of $\eta_{L_w^u w^u}$ and induces a lower union wage. This, in turn, tends to reduce the net gain from organization; the wage gain to workers is less.[13]

A graphical representation of the union's problem is given in Figure 1. The union wage is on the vertical axis and $1-G(\alpha^u)$, the proportion of firms that are unionized, is on the horizontal axis. The locus W shows the solution for the optimal union wage for each α^u given by first order condition (1). Its upward slope indicates that the wage is higher when coverage is greater. The locus R represents the optimal extent of coverage for each wage from first order condition (2). The intersection of loci, shown by point C, shows the simultaneous solution to equations (1) and (2) defining the union's optimal wage and organization policies.[14] Suppose the product demand elasticity in an industry falls. This shifts the locus R to R', enabling the union to cover more firms for every w^u, and the locus W to W', enabling the union to obtain a greater wage for every R. The new solution to the union's problem is at point D, with higher wages and greater coverage.

Econometric Implications

The model implies that we will observe industrial union coverage falling in the costs of organization and in the elasticity of product demand (in absolute value), and rising in entry costs. This leads to an equation such as

$$R_k = Z_k\gamma + \mu_k.$$

where R_k is industry k's unionization rate, Z_k represents observables that affect union organization costs, product demand elasticity, and entry barriers[15] for industry k, and μ_k is the least squares disturbance term reflecting random events and shocks that affect these factors. In the context of our model, $R_k = 1-G(\alpha^u)$.[16]

Consider estimating the effect of union coverage on union wages. The literature typically estimates a wage equation for union workers with the union coverage in the worker's industry as a regressor, as

$$\ln w_i^u = X_i\beta_0 + R_{ik}\beta_1 + \epsilon_i.$$

The vector **X** is a set of individual characteristics, R is as defined above, and ϵ is the disturbance.[17] In terms of our model, (4) is the solution to first order condition (1) for w^u in terms of R. The elasticity of demand parameter A is included in the disturbance term ϵ.

The OLS estimate of β_1 is unbiased if ϵ and R are orthogonal. We predict that this does not hold because the union chooses both wages and the extent of organization. Any factor related to product demand elasticity (included in ϵ) will affect the extent of union organization, implying that ϵ and R are correlated. The bias that results can be seen in Figure 1. A reduction in product demand elasticity shifts the loci from W to W' and from R to R' and the equilibrium from C to D. The OLS estimate of β_1 in equation (4) will estimate the locus of these equilibrium points, given by W*. The standard interpretation of β_1 is the union wage gain due to an increase in union organization in an industry. This, however, is the slope of the locus W (or W'). Thus, we predict that OLS estimates are positively biased. Too much of the effect on wages is attributed to coverage when in fact unobservables cause both to be higher. Our empirical work tests this prediction.

DATA AND RESULTS

The Data

To estimate the wage equation, data on individual workers are taken from the 1988 March and the May-June matched samples of the Current Population Survey (CPS). The sample is limited to unionized, non-agricultural, non-white collar, civilian workers between the ages of eighteen and sixty-five, and who are asked a set of job and earnings related questions.[18] These questions include "On this job, is ... a member of a labor union or of an employee association similar to a union?"; those

TABLE 1
Means of Varibles for Union Workers

	Union Members	Union Coverage
Education	13.910	13.995
Age	40.624	40.390
Married	0.7153	0.7112
Nonwhite	0.1258	0.1573
Female	0.3635	0.3817
City	0.4862	0.4745
South	0.1898	0.2049
West	0.1857	0.1914
Northeast	0.2983	0.2863
Wage	11.375	11.206
Hours	40.229	40.153
N	5,331	5,931

Source: 1988 May, March and June Current Population Surveys.
Variable definitions: Union Membership = those workers that report being a member of a union; Union Coverage = those workers that report being covered by a union contract; Education = years of education for the individual; Age = workers age in years; Married = 1 if the individual is married and zero otherwise; White = 1 if the individual is white and zero otherwise; Female= 1 if the individual is female and zero otherwise; City = 1 if the individual lives in an MSA of 1,000,000 or more and zero otherwise; South = 1 if the individual lives in the southern region and zero otherwise; West = 1 if the individual lives in the western region and zero otherwise; Northeast = 1 if the individual lives in the Northeast region and zero otherwise; Hours = usual hours worked per week; Wage = usual weekly earnings/usual hours worked per week.

responding "no" to this question are asked "On this job, is ... covered by a union or employee association contract?" This allows determination of individual union status. There are two possible definitions of a union worker: one who is a union member or one whose job is covered by a union contract. Both definitions are utilized. The final sample contains 5,328 union members and 5,928 workers covered by union contracts. The CPS also provides the standard set of demographic variables used in wage equations. Table 1 lists these variables with their means for both the union member and union coverage samples.

Our proxy for union coverage is the percent of the industry's work force that is unionized. Estimates of this are taken from Curme, Hirsch, and MacPherson [1990] and matched to individuals by their reported industry code. The variable is reported based on union membership and union coverage status. Both measures are used.[19] Table 2 presents the descriptions, sources, and means of these and the other proxy variables discussed below.

The model implies that percent organized is influenced by the elasticity of product demand, the costs of union organization, and entry barriers. We use the following proxies for the costs of organization: the geographic dispersion of employ-

TABLE 2
Descriptive Statistics of Industry Variables
(Based on a sample of 138 industries)

	Description	Source	Mean	St. Dev.
Union Membership	The percent of an industry's workers reporting union membership.	Curme, Hirsch and Macpherson	0.1921	0.1468
Union Coverge	The percent of an industry's workers that are covered by a union contract.	Curme, Hirsch and Macpherson	.2092	0.1522
Dispersion Index	An index of the geographic dispersion of employment in an industry.	County Business Patterns	1458.03	607.84
Employment Variance	The variance of industry employment across states.	County Business Patterns	1.367	1.650
Right-to-Work	Percent of industry employment located in right to-work states.	County Business Patterns	0.3358	0.1262
Concentration	The industry four-firm concentration ratio.	Economic Census	0.2717	0.2158
Small to Large	The ratio of the number of establishments with 50 or fewer employees to those larger in an industry.	County Business Patterns	23.073	58.048
State Coverage	The sum of the percent of industry j employment in state i times the percent organized in state i (for membership and coverage respectively.)	County Business Patterns and Curme, Hirsch, and Macpherson	0.1663	0.0204
Representation Cases	The percentage of NLRB unfair labor practice cases that are representation cases.	Handbook of Labor Statistics	0.1996	0.0555
Percent Blue Collar	The percentage of the industry workforce that is blue collar workers.	Employment and Earnings	0.7720	0.1387
Share of Imports	The share of imports in the total value produced in the industry.	Trade and Employment	0.0726	0.1183

ment in the industry, the variance of industry employment across states, the percent of the industry's employment located in right-to-work states, the industry's four-firm concentration ratio, the ratio of the number of small establishments to large establishments in the industry, the average of state unionization for states where the industry is located, the percentage of industry unfair labor practice cases that are representation cases, and the percent of the industry's workforce that is blue collar.

If workers in an industry are concentrated geographically, the union is able to capitalize on overlapping benefits of organizing effort, reducing the costs of organizing more firms. A geographic dispersion index is constructed to measure the physical dispersion of employment within an industry. This is done by finding the state with the largest employment in the industry and the mean, employment-weighted distance to the remaining states. This measure is larger as employment is more evenly dispersed across states and/or located physically farther apart. We expect this index to be negatively related to percent organized. A related measure is the variance of industry employment across states. We expect this to have a negative impact on percent organized.

Right-to-work laws directly raise the cost of union organization, thus are expected to reduce percent organized.[20] Also, their presence may indicate a hostile environment for union organizers. Our measure of the importance of right-to-work laws is the percent of the industry's workforce located in right-to-work states.

Industry concentration should be positively related to union organization. First, the union can capture a relatively large share of the industry by organizing the largest firms, implying lower organizing costs. Also, concentrated firms may face downward sloping demand curves for their products implying lower elasticities of labor demand. Further, concentration may proxy for entry barriers.[21] Concentration is measured by the industry's four-firm concentration ratio.[22]

In an industry with many small firms the union must organize many firms before capturing an appreciable share of the industry's workforce, implying higher organizing costs and a lower level of unionization. The importance of many, small plants is measured by the ratio of the number of establishments with fewer than 50 employees to the number with 50 or more employees.

A high degree of unionization within a state indicates a prevailing attitude favoring unions, suggesting that union organizing efforts will be more effective.[23] We measure this as the sum of the percent of industry employment in each state weighted by the percent of a state's workforce that is unionized (summed across states). This is larger when a larger share of industry employment is in states with a higher degree of unionization.

Employer resistance increases the cost of and thus reduces union organization. The degree of employer resistance is proxied by the percent of representation cases in total unfair labor practice cases for the industry.[24] As the percentage of representation cases increases, employers are spending greater resources to fight unionization.

We also include the percent of the industry's employees who are blue collar. In industries that are predominantly white collar, there is less "room" for unionization and thus we should observe a lower organization rate.

TABLE 3
Estimates of the Determinants of Percent Organized[a]
(absolute value of t-values in parenthesis)

	Union Membership (1)	Union Coverage (2)
Intercept	-3.494	-4.715
Dispersion Index	-0.0009**	-0.0009**
	(5.48)	(5.87)
Employment Variance	-0.1807**	-0.1816**
	(3.99)	(4.25)
Right-to-Work	0.1495	0.1174
	(1.14)	(0.94)
Concentration	0.4754	0.3851
	(1.14)	(0.94)
Small to Large	-0.0057*	-0.0059*
	(1.67)	(1.85)
State Coverage	1.885**	1.728**
	(2.26)	(2.23)
Representation Cases	-9.159**	-8.817**
	(4.14)	(4.16)
Percent Blue Collar	1.853**	1.826**
	(2.54)	(2.63)
Share of Imports	0.1726	-0.0620
	(0.18)	(0.05)
R-Squared	0.4149	0.4212
Observations = 138		

a Variable definitions and sources in Table 2.
* Indicates significance at the 10 percent level.
** Indicates significance at the 5 percent level.

Unfortunately, there are no estimates of demand elasticities for a variety of disaggregate industries. Thus, we do not have any direct measures of product demand elasticities. One variable that we hypothesize is related to product demand elasticity is the importance of import competition. Greater import competition raises product demand elasticity for the domestic industry by increasing the number of substitute products available. Our proxy for this is the share of imports in the total value of shipments in the industry.[25]

These variables are collected from government sources and are tabulated by Census industry. The industry is included if four or more workers in our CPS sample are in the industry and the proxy variables are available.[26]

Results

Table 3 presents the results from the estimation of the percent organized equation. Column 1 corresponds to the use of union membership to measure organization and column 2 to the use of union coverage. The dependent variable is transformed by

the "log odds" transformation, $\ln(R_k/(1-R_k))$, so that it varies over [- ∞, +∞] rather than being constrained to [0,1].[27]

Examining the set of organization cost proxies first, we find that most of the results are as expected. The geographic dispersion index is negative and significant in both specifications. The other measure of worker dispersion, the industry employment variance across states, also is estimated to be negative in both specifications.

Right-to-work laws yield a positive coefficient, but is not significant. The sign is the opposite of our prediction. However, the coefficient of the state coverage variable is positive and significant in both specifications, as anticipated. This variable is intended to account for the sentiment toward unions in states where the industry is located, as may the right-to-work variable, thus its inclusion may explain the perverse sign of the right-to-work variable.[28]

The concentration ratio has a positive and insignificant effect in both specifications. The small to large variable is found to have a negative effect and is significant at the 10 percent level. This provides some support for our prediction that the union is more successful at organizing when the industry is dominated by large firms.

The percent of industry unfair labor practice cases that involve representation reduces the industry unionization rate, consistent with the idea that it raises the cost of organization. Also, a greater percent of blue collar employment increases unionization.

As a proxy for the elasticity of product demand for the domestic industry, one expects the share of imports in the industry to be negatively related to the percent organized. The results do not bear this out. The estimated coefficient is insignificant in both specifications and is negative only in the coverage equation. However, this variable is a crude proxy.

To summarize, we find evidence that the costs of organization play an important role in determining the industry's union coverage. We cannot be sure of the effects of the elasticity of product demand, largely because we do not have a good measure of demand elasticities by industry.

Table 4 presents the estimates of log wage equations for unionized workers. Columns 1 through 3 utilize the union membership definition of percent organized while columns 4 through 6 use the coverage definition. Columns 1 and 4 show the OLS estimates of the relationship between union wages and percent organized.[29] This is comparable to the usual specification in the literature. Results on the standard control variables bear no surprises.

The OLS estimates indicate that union workers realize greater wage benefits in industries with a higher extent of union organization. Column 1 shows that a 10 percent increase in the fraction of the industry's workers who are union members is associated with a 3.36 percent higher union wage. Column 4 indicates that a 10 percent increase in the percent of the industry's work force that is covered by a union contract implies 2.55 percent higher union wage. These results are consistent with previous studies [Freeman and Medoff, 1981; Holzer, 1982; Hirsch and Neufeld, 1987; Hundley, 1987; Curme and MacPherson, 1991; Belman and Voos, 1993].

We predict that OLS overestimates the causal effect of union coverage on wages. Columns 2 and 5 of Table 4 estimate the union wage - percent organized relationship

TABLE 4
Union Log Wage Equations with Percent Organized[a,b]
(absolute value of t-values in parentheses)

Column	1	2	3	4	5	6
Specification	OLS	2S	Endog.	OLS	2S	Endog.
Intercept	0.8089	0.8107	0.8194	0.7478	0.7388	0.7582
Education	0.0241	0.0256	0.0235	0.0271	0.0285	0.0268
	(9.46)	(10.02)	(9.23)	(11.03)	(11.57)	(10.88)
Age	0.0434	0.0456	0.0444	0.0449	0.0464	0.0452
	(13.87)	(14.30)	(14.03)	(14.88)	(15.34)	(14.99)
Age Squared	-0.0005	-0.0005	-0.0005	-0.0005	-0.0005	-0.0005
	(12.26)	(12.65)	(12.41)	(12.96)	(13.36)	(13.07)
Married	0.0315	0.0340	0.0312	0.0276	0.0300	0.0273
	(2.85)	(3.05)	(2.83)	(2.60)	(2.82)	(2.58)
Nonwhite	-0.0327	-0.0375	-0.0329	-0.0235	-0.0285	-0.0235
	(2.44)	(2.78)	(2.46)	(1.81)	(2.19)	(1.81)
Female	-0.2222	-0.2288	-0.2218	-0.2252	-0.2292	-0.2253
	(18.78)	(19.23)	(18.77)	(19.92)	(20.19)	(19.93)
City	0.1072	0.1052	0.1053	0.1091	0.1075	0.1077
	(10.92)	(10.62)	(10.72)	(11.54)	(11.30)	(11.39)
West	0.0904	0.0880	0.0831	0.0861	0.0852	0.0806
	(6.58)	(6.30)	(6.00)	(6.54)	(6.38)	(6.07)
South	-0.0128	-0.0102	-0.0167	-0.0246	-0.0217	-0.0277
	(0.93)	(0.74)	(1.21)	(1.90)	(1.67)	(2.13)
Northeast	0.0139	0.0084	0.0097	0.0180	0.0144	0.0149
	(1.14)	(0.68)	(0.79)	(1.51)	(1.19)	(1.23)
Membership	0.3301	———	0.2355	———	———	———
	(9.50)		(5.48)			
Coverage	———	———	———	0.2520	———	0.1779
				(8.16)		(4.47)
Predicted Membership[c]	———	0.1390	———	———	———	———
		(3.30)				
Predicted Coverage[d]	———	———	———	———	0.1140	———
					(2.90)	
Residual Membership[e]	———	———	0.2047	———	———	———
			(3.73)			
Residual Coverage[f]	———	———	———	———	———	0.1489
						(2.94)
R-Squared	0.3034	0.2930	0.3053	0.3055	0.2987	0.3065
N		5328		5928		

a. Variable definitions and sources as in Tables 1 and 2.
b. A set of detailed occupation dummies are included in all regressions.
c. Predicted value of percent membership from column 2 of Table 3.
d. Predicted value of percent coverage from column 4 of Table 3.
e. Residual from log odds percent membership equation from column 2 of Table 3.
f. Residual from log odds percent coverage equation from column 4 of Table 3.

controlling for the endogeneity of organization with 2SLS. The coefficient estimates on the predicted value of percent organized for both columns 2 and 5 are positive and significant, but the magnitude of the coefficient is about 58 percent less than the OLS estimate in the union membership specification and 55 percent smaller using the coverage variable.[30]

A formal test of the endogeneity of union organization is presented in columns 3 and 6. The procedure is to include both the percent organized variable and the residual from the percent organized equation. Statistical significance of the coefficient on the residual implies rejection of the null hypothesis of no endogeneity [Garen, 1987].[31] The coefficient on the percent organized variable also gives a consistent estimate of the union wage-percent organized relationship.

The findings show a positive and significant coefficient on the residual for both specifications, rejecting the hypothesis of no endogeneity and indicating a positive bias of OLS. The coefficients on the percent organized variables are positive and statistically significant but smaller than the least squares estimates. The coefficients are 29 percent smaller for both the membership and coverage specifications.

CONCLUSIONS

The basic hypothesis of this paper is that both union wages and the extent of union coverage of an industry are endogenous. We model a union that selects coverage and wages in a setting with a competitive product market and unrestricted entry. Our model implies that part of the observed association between union wages and percent organized is due to reverse causality, i.e., more unionization occurs where unions can extract higher wages. Thus, too much of the wage effect is attributed to increases in organization.

Empirical tests support our approach. The exogeneity of union coverage in wage determination is rejected and it is shown that OLS overestimates the true relationship between wages and percent organized. The bias is found to be over 25 percent - suggesting that the standard estimates of this relationship found in the literature have a substantial bias.

NOTES

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1. The theoretical section defines extent organized as the percent of firms in an industry that a union has organized. Empirically, it is defined as the percentage of workers in an industry that are unionized.
2. In this section, we do not distinguish between union coverage and union membership, but do so in the empirical section.
3. This is holding constant the number of firms in the industry. Consideration of entry requires further analysis. See below.
4. The production function suppresses capital.
5. Thus, the model is similar to Kuhn [1988] and Chezum and Garen [1996].

6. We assume that V is constant across individuals. Kuhn [1988] treats the managers' opportunity cost as endogenous. For our purposes, this is not needed.
7. The nonunion wage is assumed fixed by a competitive nonunion labor market.
8. Factors determining the position of the demand curve are implicit. Naturally, those that shift the demand curve outward lead to a higher price.
9. If the production function is homogeneous of degree one in capital and labor, then it follows that it is homogeneous of degree r<1 in labor.
10. Employment prior to unionization is entered into the cost function as union organizers must deal with all workers at a firm to obtain representation.
11. Another cost of raising the wage might be increased employer resistance.
12. See Chezum [1992] for the details of these derivations.
13. Chezum [1992] and Chezum and Garen [1996] consider a similar model with a wage and employment setting union. Essentially, the same results appear.
14. The R locus must be steeper than the W locus for stability.
15. Our proxies for these are listed in Table 2.
16. Below, we estimate industrial union coverage equations using various proxies for organization costs and demand elasticity.
17. The vector **X** includes the usual variables used in wage equations, such as education, age, and several demographics. See Table 1 for a list.
18. Only those who will not be re-interviewed in the subsequent month (the outgoing rotations) are asked these questions.
19. The coverage variables are based on Census Industry Codes, which correspond approximately to SIC 3-digit and some 2-digit codes. A total of 138 industries are in the sample.
20. For empirical support, see Seeber and Cooke [1983] and Hirsch [1980]. Moore and Newman [1985] review these effects.
21. See Hirsch and Addison [1986, 60] and the related discussion of Abowd and Farber [1990].
22. Because Census industry codes do not exactly match SIC codes, a sales-weighted average of the concentration ratio for component industries is constructed to get an estimate of concentration for a Census industry.
23. The presence of right-to-work laws also may indicate the general attitude toward unions in a state. Our state coverage variable may account for some of this influence.
24. We thank an anonymous referees for suggesting this and the percent blue collar variable (discussed below).
25. Indirect support for this is in MacPherson and Stewart [1990] and Abowd and Tracy [1989], who find a negative effect of import competition on union wages, consistent with imports raising demand elasticities.
26. It is possible that some of the industry variables depend in part on union coverage. For example, unionization may induce firms to locate in right-to-work states. However, other exogenous factors also influence location decisions and the other industry variables. To estimate our model, it is necessary to assume that the exogenous factors affecting these industry variables dominate.
27. The disturbance term in this specification is heteroskedastic so weighted least squares is applied. [Greene, 1990, 667-71].
28. The correlation between these two variables is -.74. When the state coverage variable is dropped from the regression, the right-to-work variable becomes negative, although statistical significance is not high.
29. Note that the standard errors of the percent organized variables are biased downward due to the matching of industry data to individual data.
30. These percentages are the difference between the coefficients over the OLS coefficient, e.g., for the membership equation we have (.3301 - .1390)/.3301.
31. If ϵ and μ are normally distributed, it follows that $E(\epsilon|P) = r_{\epsilon\mu}/r_{\mu}^2)\mu_{ik}$, where $r_{\epsilon\mu}$ is the covariance between ϵ and μ and r_{μ}^2 is the variance of μ. The residual term μ from equation (3) may be included in equation (4) giving $\ln w_i = X_i\beta_0 + R_{ik}\beta_1 + \mu_{ik}\xi + \nu_i$, where ξ is an estimate of $r_{\epsilon\mu}/r_{\mu}^2$. Estimating equation (3) and substituting the residuals for μ_{ik} in above gives consistent parameter estimates. The estimate of $r_{\epsilon\mu}/r_{\mu}^2$ tests for endogeneity in the extent of organization. Under the null hypothesis of no endogeneity, $r_{\epsilon\mu} = 0$. The null is rejected if the estimate is significantly different from zero. The sign of $r_{\epsilon\mu}/r_{\mu}^2$ indicates the direction of the bias.

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