The Impact of Labor Unions on the Wages of Union and Nonunion Workers: Revisited

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In this paper I use Current Population Survey data** on individual workers, who are either members of a labor union or are not, to study the effect of the degree of unionization on the wages of both classes of workers. I introduce both the degree to which an industry's labor force is unionized as well as the degree to which workers in a given metropolitan area are organized. My findings are that an industry's union density significantly influences the wages of union workers only and that union density in a geographical area significantly affects the wages of both union and nonunion workers. (*JEL* Classification: J51)

I. Introduction

Since the pioneering work by H. Gregg Lewis (1963), most studies of labor union effects have focused on the size of the union/nonunion wage differentials. The impact of unionism on the wage rates is exerted

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**My estimation is based on the May 1979 CPS data file provided by the Bureau of Labor Statistics (BLS). The reason we could not use a more recent CPS file is as follows: (1) data on the principal explanatory variables, the proportion of workers unionized, in the industries and the SMSAs are taken from Freeman and Medoff (1979), which is the only source from which estimates of the proportion of workers unionized are available; and (2) the questionnaires of the CPS changed in 1980, and new data files do not provide information on the individual worker's union coverage.

[**Seoul Journal of Economics** 1995, Vol. 8, No. 1]

through both union membership and the extent of union organization in an industry or in a labor market (Lewis 1983; Freeman and Medoff 1984). The wages of union workers tend to be higher, all else the same, the greater the extent of unionization in the relevant industry or labor market. The reason is that the ability of unions to achieve larger wage gains increases when there are few nonunion competitors. Thus, Freeman and Medoff (1981) suggest that the percentage of workers organized is regarded as an important determinant of union power.

The wages of nonunion workers may also be influenced by the extent of labor organization. Most discussions of the effects of unions on nonunion wages have centered on two mechanisms working in opposite directions: the "threat effect" and the "crowding effect" (Rosen 1969; Kahn 1978; Freeman and Medoff 1981; Moore et al. 1985; Podgursky 1986). Union wage gains may compel nonunion firms to raise their wages because of the threat of unionization, or because an increasing wage differential will negatively affect nonunion workers' efforts. This is called the threat or morale effect. On the other hand, union wage gains will reduce employment in the union sector and increase the supply of nonunion labor. If labor shifts from the union to the nonunion sector, this crowding effect (also called the labor-spillover effect) will depress nonunion wages and increase the wage differential. Which of these effects dominates in a given economy and at a certain period is an empirical issue.

A number of studies have analyzed the effects of unions on both union and nonunion workers utilizing micro data. Freeman and Medoff (1981) estimate separate union and nonunion earnings equations in which the extent of unionization is an explanatory variable. They used the 1973-75 Current Population Survey (CPS) data for manufacturing production workers. Their major findings are: (1) union density has a strong positive effect on the wages of union workers; (2) but it has either no effect or a positive and weak effect on the wages of nonunion workers.

In contrast, Podgursky (1986) reports evidence of the positive effect of industry unionization on the wages of both union and nonunion workers when the 1979 CPS data are used. Moore et al. (1985) also find a positive and significant effect of industry union density on both union and nonunion wages using aggregated CPS data for the period 1973-79.

The impact of unions on the wages of nonunion workers may differ across individual groups of workers. Detailed investigations of the

characteristics of workers who gain or lose from working in a highly unionized geographic area have been made by Kahn (1978, 1980) and Holzer (1982). They find that non-union women and young blacks suffer from working in a highly unionized SMSA.

Thus, it is not clear from these studies whether, or to what extent does the degree of unionization affect the wages of nonunion workers. In this paper, we examine cross-section data on individual workers to measure the effects of union density in an industry or in a geographic area on the wages of union and nonunion workers. This paper is organized as follows: In section II, a model will be developed to examine the impact of union density on the wage rates; in section III, the data will be discussed; in section IV, empirical results will be reported; and in section V, we offer some conclusions.

II. The Model

Proper assessment of the effects of the extent of unionization on union and nonunion wages requires that the following be considered in constructing a model. First, the variable measuring union density within industry (three-digit) which is used in earlier empirical work captures only the intra-industry threat effect. If there exist substantial threat effects across industries, i.e., the wages in weakly unionized industries are influenced by those in heavily unionized industries, the three-digit industry union density cannot capture these inter-industry wage spillovers. Previous studies (Eckstein and Wilson 1962; McGuire and Rapping 1968) have shown that there exist significant inter-industry wage spillovers from a key group of industries such as the steel and the automobile industries in the United States.

Secondly, the use of geographic area (SMSA) union density as a variable captures the effects of area-wide unionism on union and nonunion wages across industries. However, a possible bias in measuring the effects may result if the degree of unionization in an industry-SMSA cell is correlated with the overall degree of unionization in the SMSA. In such case, the use of the SMSA union density variable without the industry union density variable will result in the coefficient of the SMSA union density variable reflecting both intra-industry and inter-industry wage spillover effects.

Thirdly, it is desirable that the data be restricted to production workers in manufacturing, not only because unionized workers are primarily blue-collar labor but also because the threat effect may be diluted in

a heterogeneous sample which includes professional, technical, and managerial employees. Furthermore, the use of industry union density as a variable is appropriate only for industries with nationwide product markets such as manufacturing, because the industry union density data are nationwide averages for three-digit industries (Holzer 1982).

Therefore, to measure the impact of unionization on the wages of union and nonunion workers properly, we include both industry and geographic area (SMSA) union density as variables in the wage determination model, and we restrict our sample to manufacturing production workers.

The model we use is:

$$\ln (WU_{ijk}) = a_1 X_{ijk} + a_2\, IND_j + a_3\, SMSA_k + a_4\, T_j + a_5 T_k + \varepsilon^u_{ijk}$$
$$\ln (WN_{ijk}) = b_1 X_{ijk} + b_2\, IND_j + b_3\, SMSA_k + b_4\, T_j + b_5 T_k + \varepsilon^n_{ijk},$$

where X is a vector of individual worker's characteristics; IND_j is a vector of industry characteristics; $SMSA_k$ is a vector of SMSA characteristics; T_j, T_k are industry and SMSA union densities, respectively; and ε^u, ε^n are random disturbances (i = individual, j = 3-digit industry, k = SMSA).

These wage equations are estimated for manufacturing production workers who reside in the SMSAs. The dependent variable is the natural log of hourly earnings for the individual worker. The semi-log form follows the standard human capital earnings model (Mincer 1974). The hourly earnings variable is obtained as weekly earnings divided by weekly hours. The union and nonunion samples are divided by whether a worker is covered by a collective bargaining agreement rather than by the union membership status, since nonunion workers covered by collective bargaining agreements receive identical benefits as union members.

The term X is a set of independent variables including demographic background (sex, race, marital status, veteran status, number of dependents), education, labor market experience (measured as age minus education minus 6) and its square, a part-time dummy, 3 region dummies (Northeast, North-Central, and South), 4 occupation dummies,[1] and 19 industry dummies.[2] These variables can capture varia-

[1]The occupation dummies used are craftsmen, operatives except transport, transport operatives, and non-farm laborers (the excluded group is service workers).

[2]I use two-digit Census industry dummies, and the excluded is miscellaneous manufacturing. Ordnance industry is not included in this regression due to lack

tion in human capital investments and other worker and job characteristics influencing earnings. Note that the two-equation wage model used here allows the coefficient of the earnings function to differ between the union and nonunion sectors.

The explanatory variables of interest in this study are the industry and SMSA union densities which are measured as the proportion of production workers unionized in the three-digit Census industry (CIC) and the SMSA. In the union sample, the coefficient of industry union density measures the degree of union power within the three-digit industry while the coefficient of SMSA union density represents the areawide union power. On the other hand, in the nonunion sample the coefficients of these variables, b_4 and b_5, capture the nationwide intra-industry threat effect and the areawide inter-industry threat effect, respectively.

An important point in the estimation of the industry and SMSA union density effects on union and nonunion wages is the extent to which the effects of the relevant industry and SMSA factors are accounted for. The reason is that an omitted control variable which is partially correlated with both union density and wage rates will bias the estimated coefficients of the industry and SMSA union density variables. For this reason, variables measuring industry and SMSA characteristics that might be correlated with both wage rates and union density are included in the regression.

For industry-level control, four industry variables are included: average establishment size, the ratio of total wages to value added, the four-firm concentration ratio, and the injury and illness rate in three-digit industries (CIC). The average establishment size accounts for the well-known positive effect of the employer's size on wages and the potential positive correlation between the extent of unionism and establishment size.[3] Numerous studies have reported that wage rates are higher in large plants (firms) than in small ones, which reflects at least in part the higher cost to large employers of judging labor quality (Stiglitz 1976; Mellow 1982). Also, Unionization is more likely to occur in industries with larger establishments as a result of lower average organizing costs.

The ratio of total wages to value added accounts for the possible negative association of labor intesity (labor-to-capital ratio) with wage

of data on industry characteristics.

[3]Establishment rather than firm size is chosen since most bargaining contracts are not firm-wide in manufacturing (Hirsch and Berger 1984).

rates and the potential negative effect of labor intensity on industry union density. At a theoretical level, the marginal productivity of labor is positively related to capital intensity, and it has been found that wage rates are negatively associated with the ratio of total wages to value added (Masters 1969). In addition, there may exist a positive correlation between industry union density and capital intensity because unions tend to be in a strong position when wages are a small percentage of unit costs in the industry.

The four-firm concentration ratio captures the possible impact of industry organization on the wage rates and the likelihood that unionization is higher in more concentrated industries. Weiss (1966) reports that concentrated industries tend to pay higher wage rates for given occupations. Union organizers are likely to concentrate their efforts in industries which have a greater ability to pay higher wages.

The injury and illness rate is included to control for the potential effect of dangerous work conditions on wages and their possible correlation with union density. There exists some evidence that workers are compensated by the market for dangerous job characteristics (Smith 1979).

For SMSA-level control three SMSA variables are included: population size of the SMSA, the proportion of non-whites in the SMSA population, and the unemployment rate in the SMSA. The SMSA population size accounts for the differences between the labor markets of larger and small urban areas (Holzer 1982). The proportion of non-whites accounts for the possible negative impact on wage rates and its potential positive correlation with SMSA union density. Kahn (1980) suggested that the proportion of blacks may approximate the degree of labor crowding in low-paying jobs within an SMSA. It is reported that workers are more likely to vote for union representation when they believe that they are treated unfairly (Farber and Saks 1980). Finally, the SMSA unemployment rate is used to control for the negative impact of unemployment on wage rates and its possible association with union density in local labor markets.

Inclusion of these control variables minimize the possibility that the measured industry and SMSA union density effects on the wage rates are biased.

III. The Data

This type of empirical study requires a large micro cross-section data

set. We need not only the individual earnings and union-coverage but also detailed information on the characteristics of individuals, industries, and SMSAs.

Much of the information we need can be obtained from the CPS data file published by the Bureau of Labor Statistics (BLS). The CPS is the monthly household survey used by the BLS to calculate the official unemployment rate. It contains many questions regarding the demographic and socioeconomic characteristics of household members. In addition to earnings data, the CPS file includes information on individual workers' characteristics such as age, sex, race, education, marital status, veteran status, union membership and coverage, residential location, etc.

Our estimation is based on the May 1979 CPS Supplement provided by the BLS. The total usable records of the May 1979 CPS are about 59 thousand employed workers. However, only 25 percent of the total CPS sample were asked the questions on earnings and hours of work in May, 1979. We restrict the samples to manufacturing production workers living in SMSAs. As a result, the samples used to estimate the equations of this study consist of 1,503 workers. Of these, 827 workers are the union sample and 676 workers are the nonunion sample.

Data on the principal explantatory variables, the proportion of workers unionized, in the various industries and the SMSAs are taken from Freeman and Medoff (1979). Their estimates are based on the May 1973-75 CPS file, and their study is the only source from which estimates of the proportion of production workers unionized are available. For this we could not use a more recent CPS file.

The CPS data file lacks information on industry and SMSA characteristics, which we compiled from other sources. Average establishment size is measured as the number of all employees divided by the number of establishments in each 3-digit CIC industry in 1977. Employee and establishment data by Standard Industrial Classification (SIC) are available from U.S. Department of Commerce, Bureau of the Census, *1977 Census of Manufactures:* Volume I, Table 1. These data are adjusted to 3-digit CIC industry classification of the CPS sample, using a conversion table published by the Bureau of the Census.[4]

The ratio of total wages to value added is measured as the payroll for all employees divided by value added in each 3-digit CIC industry in 1977. Data source and the method of adjusting industry classification

[4]See CPS Technical Documentation, May 1978, Appendix B.

TABLE 1

SAMPLE CHARACTERISTICS IN THE UNION AND NONUNION SAMPLES

Variables	Union sample		Nonunion sample	
	mean	(S.D.)	mean	(S.D.)
Hourly Earnings($)	6.93	(0.080)	5.87	(0.115)
Years of Education	12.1	(0.086)	12.1	(0.109)
Labor Market Experience (EXP = Age-Education - 6)	23.0	(0.484)	18.9	(0.555)
Industry Union Density(%)	55.5	(0.617)	44.7	(0.621)
SMSA Union Density(%)	43.6	(0.351)	38.0	(0.443)
Average Establishment Size (Workers)	154	(6.65)	99	(4.68)
Wages/Value Added(%)	44.4	(0.277)	44.2	(0.296)
Concentration Ratio(%)	40.3	(0.656)	34.6	(0.634)
Injury & Illness Rate(%)	88.8	(1.52)	80.5	(1.78)
SMSA Population Size (in thousands)	3,423	(82.0)	3,395	(93.7)
Proportion of Non-whites in SMSAs(%)	20.8	(0.301)	21.2	(0.325)
Unemployment Rate in SMSAs(%)	6.0	(0.047)	5.6	(0.049)
Proportion of Part-time Workers(%)	2.9	(0.584)	10.7	(1.19)
Proportion of Workers in Southern Region(%)	11.4	(1.10)	20.0	(1.54)
Sample Size(N)	827		676	

Note: 1. Data are from the May 1979 CPS merged with the industry and SMSA data files.

2. The numbers in parentheses are standard deviations of the means, i.e., standard deviations of the variables divided by $N^{1/2}$.

are the same as those described above.

The four-firm concentration ratio is measured as a weighted average of the fractions of shipments in 1977 accounted for by the four leading firms in the 4-digit SIC industries composing a 3-digit CIC industry. Here we use, as weights the value added in 4-digit SIC industries (see Weiss 1963). Data on four-firm concentration ratios by 4-digit SIC industries are from U.S. Department of Commerce, Bureau of the Census, *1977, Census of Manufactures*: Volume I, Table 7.

The injury and illness rate is measured as the mean number of lost workdays due to injury and illness per fulltime worker in each 3-digit CIC industry in 1978 and 1979. Data on injury and illness by SIC industries in 1978 and 1979 are from U.S. Department of Labor,

Bureau of Labor Statistics, *Bulletin* (April 1981).

Data on SMSA population size in 1980 and the proportion of nonwhites in the SMSA population in 1980 are from U.S. Department of Commerce, Bureau of the Census, *State and Metropolitan Area Data Book* (1986). Unemployment rates for the SMSA in 1979 are from *State and Metropolitan Area Data Book* (1982).

Before reporting the regression results, we compare the sample characteristics of the union and nounion sectors in our data. Table 1 summarizes the data by providing means and standard deviations of the means for individual worker, industry, and SMSA characteristics in the union and nonunion samples.

Some significant differences exist between the two sectors. The mean value of hourly earnings is greater and the standard deviation of the mean is smaller in the union sample than in the nonunion sample. This is consistent with the findings of previous studies that dispersion of wages is significantly narrower in unionized establishments due to unions' standard rate policies (Freeman 1980, 1982).

Table 1 also indicates that workers employed in larger establishments and in more highly concentrated industries are more likely to be unionized, as reported by previous studies. There is not much difference in SMSA characteristics between the union and nonunion samples although the average population size and unemployment rate are somewhat higher in the union sample.

As is well-known, the proportion of workers who live in Southern region is much smaller in the union sample than in the nonunion sample, and the same is true of the proportion of workers who are employed on the part-time basis.

IV. The Empirical Results

The estimated wage equations for union and nonunion workers are presented in Table 2. In this table, we report only the regression coefficients and *t*-statistics of the variables which are important to analyze the impact of industry and SMSA union density on earnings. The full regression results are reported in Appendix Table A. Note that in Table 2 establishment size is measured by the industry average.

The principal results can be summarized as follows: (1) both the industry and the SMSA union densities have positive and significant effects on the wages of union workers; and (2) the industry union density has a small and insignificant effect on nonunion wages, but the

TABLE 2

REGRESSION ESTIMATES OF THE UNION AND NONUNION WAGE EQUATIONS WITH INDUSTRY AVERAGE DATA ON ESTABLISHMENT SIZE

Variables	Dependent Variable: ln (hourly earnings)			
	Union sample		Nonunion sample	
Education	0.027*	(5.80)	0.036*	(6.95)
EXP(= Age-Education - 6)	0.012*	(3.96)	0.020*	(5.39)
$EXP^2/100$	-0.019*	(3.18)	-0.036*	(4.97)
SEX(Female = 1)	-0.233*	(7.74)	-0.280*	(8.07)
RACE(White = 1)	0.080*	(3.16)	0.117*	(2.98)
Industry Union Density	0.331*	(2.57)	-0.017	(0.12)
SMSA Union Density	0.380*	(2.75)	0.608*	(3.51)
Establishment Size/100	0.000	(0.18)	0.041*	(2.23)
Wages/Value Added	0.139	(0.50)	-0.535	(1.38)
Concentration Ratio	-0.018	(0.13)	-0.252	(1.36)
Injury & Illness Rate	-0.023	(0.51)	0.038	(0.60)
SMSA Population Size (in logarithm)	0.027	(1.28)	0.006	(0.20)
SMSA Proportion of Blacks	-0.192	(0.98)	-0.159	(0.56)
SMSA Unemployment Rate(%)	-0.013	(1.35)	-0.010	(0.69)
R^2	0.482		0.549	
SER	0.263		0.311	
Sample Size	827		676	

Note: 1. Other variables included are a constant, the number of dependents, and dummy variables for marital status(3), veterans, part-time, region (3), occupation (4), and industry (19). Full results are reported in Appendix.

2. SER denotes the standard error of the regression.

3. The numbers in parentheses are absolute values of *t*-statistics.

4. * : significant at the 0.05 level.

SMSA union density has a sizable and significant positive effect on the wages of nonunion workers.

Freeman and Medoff (1981) used only the industry union density. They found that there is either no spillover or a weak positive association between union density and the wages of nonunion workers (p. 570). Our findings show that when both industry and regional (SMSA) union density variables are included, although industry union density has no sizable effect on nonunion wages, there is a significant effect of the geographic area (SMSA) union density on nonunion wages. This result implies that the threat effect is dominant within the inter-industry dimension in an SMSA rather than within the nationwide 3-digit

intra-industry dimension. The union-to-union inter-industry wage spillovers within an SMSA is also supported by the fact that SMSA union density has a sizable and significant positive effect on the wages of union workers. Therefore, union environment in a geographic area is an important factor influencing both union wages and nonunion wages. The argument that there is no spillover from union density to the wages of nonunion workers is rejected.

The estimated coefficients of the worker's personal characteristics variables are consistent with those obtained in earlier empirical studies. Education and labor market experience are positively and significantly associated with hourly earnings. When we compare the coefficient size of these variables between the union and nonunion sectors, we find that nonunion sector wages are more responsive to individual worker levels of education and experience, as reported by previous studies (Bloch and Kuskin 1978; Duncan and Leigh 1980). Also, in both sectors there exists significant wage discrimination by sex and by race although the degree of discrimination is smaller under unions.

On the other hand, estimated coefficients on the industry and SMSA control variables are for the most part imprecise. The SMSA variables and the industry variables with the exception of the establishment size are not significant. Similar results have been reported in other empirical studies. Weiss (1966) has pointed out that once the personal characteristics are introduced, the coefficient of the concentration ratio becomes insignificant. The implication seems to be that firms in concentrated industries do pay their employees more, but that they also get higher quality labor. Smith (1979) reported, in his review of the literature, that the effect of the injury and illness rate on wage rates is ambiguous in many cases.

Concerning the SMSA variables, the coefficients of the unemployment rate and of the proportion of blacks are, as expected, negative but not significant in both samples. Similar results were found by Kahn (1980).

Turning to the establishment size variable, although previous studies have generally found that large employers pay higher wages, Table 2 reveals that establishment size has a positive and significant effect only on the wages of nonunion workers. Note that in Table 2 we have used industry average data on establishment size. Ideally, employer size should be measured at the worker level instead of being imputed on the basis of an industry average (Mellow 1982).

The problem with the measurement of establishment size can be re-

TABLE 3

REGRESSION ESTIMATES OF THE UNION AND NONUNION WAGE EQUATIONS WITH MICRO DATA ON ESTABLISHMENT SIZE

Variables	Dependent Variable: ln (hourly earnings)			
	Union sample		Nonunion sample	
Education	0.030*	(5.58)	0.036*	(6.36)
EXP(= Age-Education - 6)	0.009*	(2.45)	0.018*	(4.33)
$ESP^2/100$	-0.011	(1.63)	-0.030*	(3.77)
SEX (Female = 1)	-0.225*	(6.62)	-0.296*	(7.78)
RACE (White = 1)	0.044	(1.39)	0.147*	(3.25)
Industry Union Density	0.274*	(2.06)	-0.045	(0.28)
SMSA Union Density	0.336*	(2.19)	0.493*	(2.57)
SIZE1 (25-99)	-0.035	(0.74)	0.022	(0.55)
SIZE2 (100-499)	-0.007	(0.16)	0.057	(1.36)
SIZE3 (500-999)	0.010	(0.20)	0.155*	(2.53)
SIZE4 (1,000+)	0.069	(1.42)	0.226*	(4.45)
Wages/Value Added	0.297	(1.66)	0.226	(0.58)
Concentration Ratio	-0.121	(0.83)	0.116	(0.62)
Injury & Illness Rate	-0.014	(0.35)	-0.061	(1.09)
SMSA Population (in logarithm)	0.038	(1.58)	-0.006	(0.18)
SMSA Proportion of Blacks	-0.177	(0.78)	-0.097	(0.31)
SMSA Unemployment Rate(%)	-0.001	(0.11)	-0.017	(1.14)
R^2	0.522		0.584	
SER	0.255		0.298	
Sample Size	612		517	

Note: 1. Other variables included are the same as in Table 2. The numbers in parentheses are absolute values of t-statistics.
2. * : significant at the 0.05 level.

examined using the May 1979 CPS Supplement which includes an employer size question. The establishment size question is "How many persons are employed by your employer at the location where you work?". For this question, the survey allowed respondents to indicate one of five exclusive categories: less than 25, 25-99, 100-499, 500-999, and 1,000 and over.

After constructing four establishment size dummies (SIZE1 = 25 - 99, SIZE2 = 100 - 499, SIZE3 = 500 - 999, SIZE4 = 1,000 +), we re-estimated the equations to investigate the effects of industry and SMSA union density on earnings. The regression results, using the micro establishment size data, are presented in Table 3. Because of missing values on establishment size for some of the observations the sample size in Table 3 is smaller than that of Table 2.

The results in Table 3 are qualitatively similar to those given in Table 2. Although there are small differences in the coefficients of the worker's personal characteristics, the main results remain the same: (1) industry union density has a strong positive effect on union wages but not on nonunion wages; and (2) SMSA union density has a sizable positive effect on both union and nonunion wages.

Turning to the establishment size dummies, Table 3 shows that they have significant effects only in the nonunion sector and that coefficients of the size dummies in the union sample are smaller than those in the nonunion sample. This is consistent with the findings of previous studies that the impact of employer size on earnings is smaller under unions. Again, the other industry and SMSA control variables are insignificant in both union and nonunion samples.

In sum, the results presented here demonstrate that the geographic area (SMSA) union density has a positive and significant effect on the wages of both union and nonunion workers while the industry union density has a strong positive effect only on the wages of union workers. These results are robust with respect to the use of micro data or industry average data on establishment size.

V. Correction for the Endogeneity of Union Status

Until now we abstract from the problem of the endogeneity of union status in the wage determination model. Union status is likely to be endogenous in the wage equation in that workers' union membership decisions tend to be related to the anticipated wage differential in their best union/nonunion alternatives. It implies that the samples of union and nonunion workers are not drawn randomly from the population of workers, or union and nonunion workers with similar characteristics are systematically different. Then, ordinary least squares (OLS) estimates of the union and nonunion wage equations will be biased and inconsistent.

Several studies have attempted to deal with this issue using the sample selectivity and simultaneous-equations models. Here, we re-examine the results obtained above using the sample selectivity model in which union status is treated as endogenous and selectivity bias resulting from unmeasured worker differences between the union and nonunion sectors is adjusted for. The model we use is based on those introduced by Lee (1978) and by Hirsch and Berger (1984). It consists of the following three equations:

$$\ln (WU_{ijk}) = a_1X_{ijk} + a_2\, IND_j + a_3\, SMSA_k + a_4\, T_j + a_5T_k + \varepsilon^u_{ijk}$$
$$\ln (WN_{ijk}) = b_1X_{ijk} + b_2\, IND_j + b_3\, SMSA_k + b_4\, T_j + b_5T_k + \varepsilon^n_{ijk}$$
$$U^*_{ijk} = c_1X_{ijk} + c_2\, IND_j + c_3\, SMSA_k + c_4\, T_j + c_5T_k + c_6(\ln WU_{ijk} - \ln WN_{ijk}) - \varepsilon_{ijk},$$

where i = individual, j = 3-digit industry, k = SMSA, and the disturbance terms are assumed to be normally distributed.

In the last equation let U^* be a latent union variable which is not observable but its dichotomous realization, U, is observed union status. This can be expressed as

if $U^*_{ijk} > 0$, then individual i joins a union ($U_{ijk} = 1$)
if $U^*_{ijk} \leq 0$, then he does not ($U_{ijk} = 0$).

As long as the worker's decision to join a union depends on the wage differential, the error terms across equations will be correlated. In addition, the argument that union and nonunion samples are not drawn randomly implies that expected values of the error terms in the union and nonunion wage equations are not zero.

$$E(\varepsilon^u_{ijk} \mid U^*_{ijk} > 0) \neq 0$$
$$E(\varepsilon^n_{ijk} \mid U^*_{ijk} \leq 0) \neq 0.$$

Heckman (1976) and Lee (1978) proposed an estimation method that the bias caused by sample selectivity is treated as a standard omitted variable problem and is controlled by inserting values of the "inverse Mill's ratio" (also called "selectivity variable") into the union and nonunion wage equations. In this model the truncation effect associated with sample selectivity in each sector may be written:

$$E(\varepsilon^u_i \mid U^*_i > 0) = \sigma_{\in u}[-f(\hat{U}_i)/F(\hat{U}_i)]$$
$$E(\varepsilon^n_i \mid U^*_i \leq 0) = \sigma_{\in n}[f(\hat{U}_i)/1 - F(\hat{U}_i)],$$

where f and F are, respectively, the density and distribution functions of a standard normal variable, and $\sigma_{\in u}$, $\sigma_{\in n}$ are covariances between the error term of the union status equation and the wage equation error terms (we drop the subscripts j, k for notational convenience). The estimate $\hat{U}_i$ is obtained using probit analysis of a reduced form union status equation which includes all exogenous variables, but not $(\ln WU_i - \ln WN_i)$.

Then, the selectivity bias adjusted wage equations which are including the inverse Mill's ratios can be expressed:

TABLE 4
REGRESSION ESTIMATES OF THE WAGE EQUATIONS USING THE SAMPLE SELECTIVITY APPROACH

Variable	Dependent Variable: ln (hourly earnings)			
	Union sample		Nonunion sample	
Education	0.028*	(5.89)	0.035*	(5.03)
EXP	0.010	(1.82)	0.006	(0.87)
$EXP^2/100$	–0.015*	(1.99)	–0.015	(1.24)
SEX(Female = 1)	–0.219*	(5.88)	–0.209*	(3.76)
RACE(White = 1)	0.106*	(2.55)	0.259*	(3.30)
Industry Union Density	0.230	(1.22)	–0.512	(1.76)
SMSA Union Density	0.292	(1.57)	0.117	(0.37)
Establishment Size/100	–0.007	(0.51)	0.000	(0.00)
Wages/value Added	0.175	(0.63)	–0.023	(0.04)
Concentration Ratio	0.010	(0.75)	–0.063	(0.25)
Injury & Illness Rate	–0.037	(0.74)	–0.042	(0.48)
SMSA Population(in log arithm)	0.035	(1.50)	0.053	(1.16)
SMSA Proportion of Blacks	–0.212	(1.08)	–0.321	(0.87)
SMSA Unemployment Rate(%)	–0.011	(1.19)	–0.007	(0.42)
[Inverse Mill's Ratio]	–0.104	(0.71)	–0.492*	(2.23)
Sample Size	827		676	

Note: 1. Estimation is done by the LIMDEP program (Selection Model). The inverse Mill's ratio is defined as $[f(\hat{U}_i)/F(\hat{U}_i)]$ for the union sector and as $[-f(\hat{U}_i)/1 - F(\hat{U}_i)]$ for the nonunion sector.
2. Other variables included are the same as those in Table 3.2. Numbers in parentheses are absolute values of t-statistics.
3. * : significant at the 0.05 level.

$$\ln (WU_i) = aZ_{ui} + \lambda_u[f(\hat{U}_i)/F(\hat{U}_i)] + \varepsilon'_{ui}$$
$$\ln (WN_i) = bZ_{ni} + \lambda_n[-f(\hat{U}_i)/1 - F(\hat{U}_i)] + \varepsilon'_{ni},$$

where Z is a vector including all the independent variables (X, IND, $SMSA$, and T_j, T_k). Note that the adjusted error terms, ε'_{ui} and ε'_{ni} will have expected values of zero.

The regression estimates of the wage equations using the sample selectivity approach are presented in Table 4. In this model estimation of the coefficients of the inverse Mill's ratios provides a test of the null hypothesis that observed union and nonunion wages are randomly selected samples from the population wage distribution. The inverse Mill's ratio coefficients reported near the bottom of Table 4 show that there exists significant sample selectivity for the nonunion sector, while no significant selectivity is present in the union sector.

As shown in Table 4, after correcting for the selectivity bias, the effects of union density become insignificant. Neither of industry and SMSA union density has a systematic impact on either sector wages. Note that the reduced form union status equation is used as a criterion of sample selection. In the reduced form union status equation, both industry and SMSA union densities have significant effects on the likelihood of union membership.

In Table 4 the result that industry union density has no significant effect on union wages is not consistent with the findings of previous studies. Also, the result that the coefficients of *EXP* and establishment size are not significant in either sample of the union and nonunion sectors is not consistent with the general findings of earlier empirical work. Lee (1978), using the sample selectivity approach, reports that these variables have a positive and significant effect on wage rates.

In the literature, it is argued that the empirical results of the sample selectivity model are much more sensitive to changes in specification and choice of data set than those of the OLS model (Lewis 1986; Freeman and Medoff 1981b). Since we have some reservations on the empirical validity of the results in Table 4, we would not conclude that the results in Tables 2 and 3 are overturned by the sample selectivity approach.

VI. Conclusions

The literature on the effect of unions on the wage rates has discussed the effects of unions on the wages of organized labor as well as on the wages of unorganized labor. Analysis of the May 1979 CPS data, with industry and SMSA union densities as explantatory variables, yields cross-section evidence in support of the threat effect. Geographic area (SMSA) union density is found to have a positive and significant effect not only on union wages but also on nonunion wages. Our findings also indicates that industry union density has a positive effect on union wages but no significant impact on nonunion wages.

The threat of unionization may exist for both the industry and the geographic area. However, the findings in this study imply that the threat effect for the nonunion sector is determined in the areawide inter-industry dimension rather than in the nationwide intra-industry dimension. This phenomenon is likely to occur if labor is not colsely tied to one specific industry (3-digit) and when movements between industries are less costly than movements between regions. Foulkes'

study (1980) of large nonunion firms also provides examples of such firms copying union wage within a geographic area (see also Freeman and Medoff 1984). Therefore, union environment in a geographic area (SMSA) is regarded as an important factor influencing the earnings of both union and nonunion workers.

A possible limitation on this conclusion is that the approach we use is a partial equilibrium analysis. In a general equilibrium model, when union wage gains lead to reductions of employment in the union sector, the nonunion sector must absorb both the displaced labor and capital. In such models, union wage gains are likely to lead in the long run to a downward pressure on nonunion wages through the so-called crowding effect.[5] However, the threat effect and the crowding effect differs in timing. The threat effect occurs in the short run, while the crowding effect takes longer to be realized if employers reduce the quantity of labor demanded by resorting to attrition, rather than through direct layoffs. If this is the case, cross-sectional analysis may not fully capture the crowding effect.

Appendix

TABLE A

FULL REGRESSION RESULTS OF THE WAGE EQUATIONS: MAY 1979 CPS DATA

Variables	Dependent Variable: ln (hourly earnings)			
	Union sample		Nonunion sample	
Education	0.027*	(5.80)	0.036*	(6.95)
EXP(age-education-6)	0.012*	(3.96)	0.020*	(5.39)
$EXP^2/100$	-0.019*	(3.18)	-0.036*	(4.97)
SEX(Female = 1)	-0.233*	(7.74)	-0.280*	(8.07)
RACE(White = 1)	0.080*	(3.16)	0.117*	(2.98)
Married[a]	0.097*	(3.18)	0.173*	(4.64)
Separated[a]	0.010	(0.17)	0.103	(1.48)
Divorced, Widowed[a]	0.084*	(2.02)	0.213*	(3.82)
No. of Dependents	-0.003	(0.36)	-0.042*	(3.89)
Veterans	0.041	(1.74)	0.053	(1.47)
Part-time	-0.035	(0.61)	-0.076	(1.79)
Industry Union Density	0.331*	(2.57)	-0.017	(0.12)
SMSA Inion Density	0.380*	(2.75)	0.608*	(3.51)

[5]This argument may not hold if the union sector is more heavily capital intensive than the nonunion sector (Freeman and Medoff 1984).

TABLE A
CONTINUED

Variables	Dependent Variable: ln (hourly earnings)			
	Union sample		Nonunion sample	
[Industry Characteristics]				
Establishment Size/100	0.000	(0.18)	0.041*	(2.23)
Wages/Value Added	0.139	(0.50)	-0.535	(1.38)
Concentration Ratio	-0.018	(0.13)	-0.252	(1.36)
Injury & Illness Rate	-0.023	(0.51)	0.038	(0.60)
[SMSA Characteristics]				
Population Size (log)	0.027	(1.28)	0.006	(0.20)
Unemployment Rate(%)	-0.013	(1.35)	-0.010	(0.69)
Proportion of Blacks	-0.192	(0.98)	-0.159	(0.56)
[Region: base = West]				
Northeast	-0.111*	(3.18)	-0.135*	(3.04)
North-Central	-0.059	(1.83)	-0.100*	(2.51)
South	-0.073	(1.70)	-0.048	(0.97)
[Occupation: base = service workers]				
Craftsmen	0.215*	(3.27)	0.350*	(5.04)
Operatives	0.091	(1.42)	0.152*	(2.24)
Transport Operatives	0.091	(1.24)	0.351	(3.37)
Laborers	0.065	(0.91)	0.025	(0.28)
[Industry Dummies]				
Lumber	0.041	(0.28)	-0.053	(0.34)
Furniture	-0.138	(1.35)	-0.236*	(2.10)
Stone, Clay, Glass	-0.062	(0.65)	-0.100	(0.71)
Primary Metals	-0.031	(0.32)	0.109	(0.85)
Fabricated Metals	-0.057	(0.70)	-0.065	(0.71)
Machinery	0.031	(0.40)	0.072	(0.84)
Electrical Machine	-0.060	(0.74)	0.076	(0.82)
Transport Equipment	0.045	(0.49)	0.129	(1.12)
Instruments	-0.142	(0.94)	0.129	(1.33)
Food	0.020	(0.23)	0.036	(0.32)
Tobacco	0.326	(1.14)	-	(-)[b]
Textiles	-0.072	(0.65)	-0.140	(1.19)
Apparel	-0.151	(1.87)	-0.049	(0.52)
Paper	-0.060	(0.66)	-0.146	(1.09)
Printing	0.124	(1.52)	-0.003	(0.03)
Chemicals	0.097	(1.02)	-0.023	(0.19)
Petroleum	0.373*	(2.32)	0.120	(0.53)
Rubber	-0.069	(0.76)	-0.077	(0.71)
Leather	-0.222	(1.45)	-0.180	(1.34)
Constant	0.797*	(3.19)	0.907*	(2.69)

TABLE A
CONTINUED

Variables	Dependent Variable: ln (hourly earnings)	
	Union sample	Nonunion sample
R^2	0.482	0.549
SER	0.263	0.311
Sample Size	827	676

Note: 1. a) The base of the marital status dummies is "Never-married"
b) The data file used in this study includes no nonunion workers in the tobacco industry.
2. The results shown are full regression estimates of the union and nonunion wage equations in Table 2.
3. SER denotes the standard error of the regression.
4. The numbers in parentheses are absolute values of *t*-statistics.
5. * : significant at the 0.05 level.

(Received March, 1994; Revised May, 1995)

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