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WAGE AND EMPLOYMENT DETERMINATION
UNDER TRADE UNIONISM: THE INTERNATIONAL
TYPOGRAPHICAL UNION

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ABSTRACT

This paper represents the first empirical application of a model of trade union behavior that has been discussed in the literature for over thirty years. The wages and employment of typographers are examined to see whether they can be usefully characterized as the outcome of a process by which the union maximizes an objective function containing wages and employment and is constrained by a trade-off between these two variables as represented by the employer's labor demand function. Our functional form assumptions permit investigation of some familiar special cases of union behavior. We find the parameter implications of both the wage bill maximization hypothesis and the rent maximization hypothesis to provide inferior explanations of the movement of wages and employment of these workers compared with our more general formulation.

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WAGE AND EMPLOYMENT DETERMINATION UNDER TRADE UNIONISM:
THE INTERNATIONAL TYPOGRAPHICAL UNION*

by

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1. Introduction

Although empirical studies measuring the effects of trade unions have multiplied in the last few years, the behavioral underpinnings of unionism remain poorly understood. This is because the issues raised in the literature on trade union goals and wage determination have been mired in fruitless methodological debates or simply have not been pursued at an empirical level. Consequently, although a variety of plausible models of unionism have been proposed, an evaluation of them in terms of their correspondence with observed behavior would rest today on barely more reliable information than was available to Dunlop (1944) when he wrote his seminal work almost forty years ago. This dearth of research is all the more remarkable when contrasted with the abundant theoretical and empirical work by economists on the behavior of firms and of families. And yet, as Farber (1978) ably demonstrated with his analysis of the United Mine Workers, there is nothing about the trade union as an institution that makes its central features impossible to characterize in a

framework analogous to purposive models in economics.^{1/}

The model of the trade union analyzed in this paper is by no means original; it is usually associated with the work of Fellner (1947) and Cartter (1959) among others. It characterizes the union as maximizing a function in which wage rates and employment are arguments and as being constrained by a trade-off between these two variables represented by the employer's labor demand function. The novel feature of this paper is that we have identified a setting that seems suitable for the operation of the model and have estimated the wage and employment functions that result from this characterization. Therefore, this represents the first empirical application of a model that has been widely discussed in the literature. Moreover, several models of trade union behavior are nested as special cases in our framework so that we are able to provide formal tests of some popular hypotheses. Our purpose is not to champion a specific model, but simply to examine whether, in fact, the particular purposive model that is common in the literature provides a viable framework for analyzing union behavior. Only through a careful documentation of a number of empirical studies will the profession be in a position to evaluate the relevance of this model.

The outline of this paper is first to describe some basic features of the newspaper industry and of the International Typographical Union (ITU) which is the union with which this paper is concerned. As is well known, this is a powerful closed shop union that operates in an industry whose technological features have changed considerably over the last 10

to 15 years. This paper focuses on a period (the years from 1946 to 1965) before the drastic changes in the nature of newspaper composition and during these years the model is less likely to have experienced structural change. We provide reasons for believing that bilateral monopoly is not an apt description of the market for typographers, but we cannot claim that our results vindicate this judgment since a bargaining model is not outlined and the estimates are interpreted in terms of the Fellner-Carder model. Since this model seems to have escaped formal description, we offer such a description in Section III and also introduce our particular functional form assumptions. In Section IV we present our experiences with estimating the model first with an excellent data set from Cincinnati and then with data on seven other unions. Some conclusions follow in Section V.

II. Institutional Setting

The organization, structure, and traditions of the ITU suggest several features relevant to an analytical model of union behavior. The structure of the ITU parallels that of the printing industry which mainly consists of geographically segmented product markets. Today, there exist approximately 1000 chapters of the union which negotiate individual contracts with local printing establishments, the most important being newspaper firms. Members are employed in the crafts associated with the mechanical composition of text and display copy which is ultimately reproduced and distributed to consumers.

Officers of the ITU on both the national and local levels appear to be extremely responsive to the wishes of their constituent typographers

and the union is frequently described as the most democratic trade union in the United States. Two active political parties compete and a rather frequent turnover of officers occurs through the electoral process. Indeed, a survey of the largest ITU local, New York #6, revealed that over one-half of the membership, at one time or another, held some union office.^{2/} Thus, the rank and file consists of individuals with the political and administrative skill and experience required to monitor and, if necessary, oppose any activity deemed not in their best interest. Referenda are conducted on all sorts of issues with voter participation reaching 60 to 70 percent even when the outcomes have marginal impacts on individual members.

Moreover, the union leaders have few incentives to entrench themselves in office. Financial remuneration, even at the highest level, differs little from journeyman wages. In fact, local officers are most often workers who perform union duties in their spare time. No particularly high status or reward is associated with the positions. The chairmanship of a local chapel is viewed as an obligation to be passed around and shared, often to be held by the individual who made the least vigorous protests. Thus, negotiated settlements are as likely to affect their own financial status as that of the "rank and file". The dichotomy between the interests of officers and of members that assumes importance in some unions appears less relevant to the ITU. For large locals, leadership amounts to a full-time job and a divergence of interests is possible though presumably tempered by the democratic procedures of the organization. Local contracts are constructed and negotiated as prescribed by union laws which have existed for decades and which require membership participation and ratification at each stage.

A further characteristic of the ITU is the rather remarkable homogeneity of its membership. Printers consider themselves to be skilled craftsmen and all members of the ITU share a similar status. All undergo the same training; there is no observable prestige differentiation, and education levels and other demographic characteristics are quite uniform. In contrast to most industrial unions which consist of workers of different vocations and varying income levels, the ITU is internally homogeneous.^{3/}

Over the years, the central organization of the ITU has been concerned with broad issues which have relevance to the union as a whole. These have focused on the union's jurisdiction over printing occupations and the proprietary right of members to employment.^{4/} By contrast, issues concerning remuneration are negotiated at the local level which in these matters operates largely independently of the national office. The wage scale negotiated is applied to all journeyman printers. Within locals, the importance of the negotiated wage rate compared with employment considerations probably varies among union members. Local hierarchies within the union membership do exist and are institutionally based. Printers are hired and fired according to a priority system which is based on seniority. All vacancies are filled from substitute lists of irregularly employed workers on this basis. Reductions in the size of the work force are completed in the same fashion. Employment considerations are likely to be more important to substitute members although the regular employees tend to dominate in sheer numbers. Moreover, there is evidence that the regular employees are not indifferent to the welfare of the "marginal" or substitute workers. Indeed, as early as 1890, the general laws of the ITU contained provisions which attempted to

distribute work evenly to all employees. (See ITU (1964, pp. 312-313).) Thus, all time accumulated in excess of the amount of hours constituting a regular daily or weekly shift is posted as overtime. When this overtime becomes equivalent to a day's pay, the regular is required to take a day off and engage a substitute as long as one is available.^{5/} Finally, union membership is sometimes viewed as a legacy to be passed from generation to generation so that family ties among the union members provide a further reason for the typical journeyman to take account of the employment effects of his union's policies.^{6/}

Therefore, the ITU is a union with a remarkable democratic tradition, with no clear divergence of interests between different groups within the union, and with an apparent concern both for the employment of its members and for their remuneration. A further attribute deserves mention: although strikes in the newspaper printing and publishing industry as a whole are not uncommon, those involving the ITU are infrequent. For instance, in 1945 (the year before our data begin) only 32 of 1,000 locals engaged in any strikes and all but one of the struck firms resumed publication within a few days.^{7/} More recently, strikes have become even more unusual. The relative unimportance of strikes is consistent with those models that account for strikes in terms of incomplete information either within the union or between the union and the employer: rates of concession are unknown and the negotiation process reveals information about what to expect from the opposition. However, in the newspaper industry, negotiations have been taking place between the same unions and newspaper firms for many decades, the ITU trade journals regularly publish

wage scales for each of the 1,000 locals, and what is sometimes described^{8/} as a "mature" collective bargaining relation obtains. Indeed, for the ITU locals whose data we use below, no strikes occurred during the 1946-65 period.^{9/}

The rarity of strikes reflects in large part the relative vulnerability of the local newspaper firm to a prolonged interruption of production. In particular, the firm's product, the prompt delivery of up-to-date information, cannot be stockpiled to withstand a shutdown so that advertisers and subscribers are apt to turn to alternative media as a result. Once a firm closes down, it is expensive to regain former customers especially advertisers who provide an average of about 75% of all newspaper revenue and who can turn to ready alternatives (television, weekly newspapers, direct mail, billboards, radio) for their purposes. By contrast, the ITU maintains a defense fund to aid striking local unions and members have the opportunity to work elsewhere in the event of the newspaper firm being driven out of business. Hence, with the newspaper firm facing a number of immediate competitors in its product market and with the typographers able to draw upon a sizable strike fund and to arrange for work in other cities, the setting is not a confrontation between two equally powerful adversaries: the union is clearly in a dominant position vis-à-vis the firm. This provides some support for interpreting the pattern of typographers' wages and employment over time as tracing out the union's preferences.

III. The Conceptual Framework

A. A General Statement

From a description of the institutional setting, we turn now to a formal statement of the union maximizing model. The union is characterized as behaving as if it possesses a twice continuously differentiable, strictly concave, objective function:

$$(1) \quad U = g\left(\frac{w}{p}, L\right)$$

where w measures the wage rate, p the price level of commodities consumed or the "cost-of-living", and L union employment. This union is assumed to be involved in producing such a small part of the economy's total output that any effect of its decisions upon the overall price level (p) may be neglected. Hence p is taken to be exogenous to the union while w and L are endogenous. The union consists of many members so that an issue arises of whose utility function is represented by equation (1). This has been a recurrent theme in the literature on trade union goals although formally the problem is no different in kind from economic models of family decision-making where the family consists of more than one individual or from the theory of the firm where there is more than one owner.^{10/} The typical ITU local has already been described as one with an unusually homogeneous membership and where conflicts of interest between the union leadership and the rank-and-file are not pronounced. Therefore, the objective function above is "the" union leader's and "he" is assumed to integrate the welfare of all the union's members.

The employer's cost-minimizing labor demand function is given by

$$(2) \quad L = f(w, r_1, r_2, \dots, r_n, X)$$

where r_i represents the unit price of input i and X is the level of output produced with $n + 1$ inputs by the firm.^{11/} As is well known, L is a negative function of w , L must be increasing with respect to at least one other input price, L increases with output (provided labor is not an inferior input), and this labor demand function is homogeneous of degree zero in all input prices.

The union is assumed to select w and L to maximize equation (1) subject to the labor demand function given by equation (2). This yields the following first-order condition:

$$(3) \quad -\frac{g_1}{g_2} = p \frac{\partial f}{\partial w}$$

where $g_1 = \partial U / \partial (w/p) > 0$ and $g_2 = \partial U / \partial L > 0$: the marginal rate of substitution of wages for employment in the union's objective function equals the cost-of-living normalized slope of the employer's labor demand function with respect to the wage rate.^{12/} This first-order condition together with the employment demand function (2) may be solved to derive the reduced form equations of the system:

$$(4) \quad w = \phi(p, r_1, r_2, \dots, r_n, X)$$

$$(5) \quad L = \psi(p, r_1, r_2, \dots, r_n, X)$$

Since an increase in the cost-of-living reduces the real value of the wage rate without disturbing the employer's structural labor demand function (2), the effect of an increase in p on the wage rate will be opposite in sign to its effect on employment. Other than this, without further restrictions on the form of the union's objective function and the labor demand function, these wage and employment equations are devoid of any unambiguous sign implications.^{13/} This dearth of qualitative predictions seems to have escaped notice in the extensive literature on this simple maximizing model.

If the reduced form equations (4) and (5) are substituted back into the union's objective function (1), then an expression is derived that relates the maximum value (call it V) of the union's objective function to the exogenous variables of the system:

$$(6) \quad V = V(p, r_1, r_2, \dots, r_n, X) \quad .$$

Through the envelope theorem it is straightforward to show that V decreases with respect to p and with respect to the price of any input that is complementary with labor and that V increases with respect to output and with respect to the price of any input that is substitutable for union labor. Moreover, the trade-off in the union's optimizing objective function (6) between increases in the prices of any two inputs is simply represented by the ratio of the derivatives of the employer's labor demand function with respect to each of the input prices:^{14/}

$$\frac{\partial V / \partial r_i}{\partial V / \partial r_j} = \frac{\partial f / \partial r_i}{\partial f / \partial r_j} \quad .$$

Since these derivatives of the labor demand function are related to the question of the degree to which this labor is substitutable for (or complementary with) other inputs, this illustrates the relevance of the production technology in constraining the union's opportunities.

B. Particular Functional Forms

In order to implement this framework, at some stage in the analysis some explicit functional forms have to be introduced. These functions should be consistent with the institutional features of the newspaper industry, they should be straightforward to interpret, and they should be computationally manageable. The approach in this paper is to specify particular forms for the union's objective function (1) and for the firm's employment demand function (2) and then to use the first-order condition (3) to solve for the corresponding reduced form system (4) and (5). Thus, the union's objective function defined over real wages and employment is specified as follows:

$$(7) \quad U\left(\frac{w}{p}, L\right) = \left(\frac{w}{p} - \gamma\right)^{\theta} (L - \delta)^{1-\theta} .$$

This function, the Stone-Geary, claims an excellent pedigree in empirical work on estimating systems of consumer demand equations though this represents its first application to union behavior. In fact, it possesses a number of attractive features for our purposes. Though it is not necessary to adhere to this interpretation, following Samuelson (1948), γ and δ may be thought of as "reference" or "minimum" or "necessary" values with

the function being homothetic to the point (γ, δ) and $w/p = \gamma$ and $L = \delta$ represent "supernumerary" real wages and employment respectively. The value of θ indicates the relative importance attached to supernumerary wages versus supernumerary employment; only when $\gamma = \delta = 0$ may θ be interpreted as measuring the relative weight of wages and employment in the union's objective function.

One appealing feature of equation (7) in this context is that it nests other models of union behavior as special cases. For instance, Dunlop's model of "maximization of the wage bill for the total membership" (1944, p. 44) is equivalent for the closed shop ITU to specifying $\theta = .5$ with $\gamma = \delta = 0$ in the objective function.^{15/} Or the rent maximization hypothesis (Rosen, 1970; de Menil, 1971) implies $\theta = .5$, $\delta = 0$, and γ equal to the competitive wage. Dynamic elements may be introduced by relating γ and δ to lagged values of real wages and employment so that the union's objectives are those of wage growth and employment growth.^{16/} Where a union designs its wage policy with reference to what another union has attained or to a nonunion wage, then γ assumes the value of this comparison wage rate.^{17/} Hence the Stone-Geary function can accommodate a number of alternative hypotheses that have received attention in the literature on union objectives.

The union's opportunity set is defined by the newspaper firm's labor demand function, the expression for which is as follows:

$$(8) \quad L = \alpha_0 + \alpha_1 \left(\frac{w}{r_1} \right) + \alpha_2 \left(\frac{r_2}{r_1} \right) + \alpha_3 X + \alpha_4 D$$

where, as before, the r 's indicate the prices of nonlabor inputs and X is the firm's output. The negatively-sloped labor demand function requires $\alpha_1 < 0$ and, if labor is not an inferior input, then $\alpha_3 > 0$. During our estimating period (1946-65), there was considerable merger activity in the newspaper industry^{18/} so, to allow for such mergers causing a shift in the labor demand function, equation (8) includes a dichotomous variable, D , that takes the value of unity when a newspaper merges with another. This parameterization is consistent with a merger resulting in an entirely different cost function for the newspaper, different in its intercept and different in its slope with respect to each of its arguments. This linear-in-the-parameters labor demand function, equation (8), generates tractable estimating equations and yet conforms to what is known about the production technology in the newspaper industry.^{19/}

The first-order condition for a maximum of (7) subject to equation (8) is $\theta/(1 - \theta) = -[(w - pr)\alpha_1]/[(L - \delta)r_1]$ which may be solved for the reduced form wage equation expressed in real terms as

$$(9) \quad \frac{w}{p} = \beta_0 + \beta_1\left(\frac{r_1}{p}\right) + \beta_2\left(\frac{r_2}{p}\right) + \beta_3\left(\frac{X \cdot r_1}{p}\right) + \beta_4\left(\frac{D \cdot r_1}{p}\right)$$

where $\beta_0 = (1 - \theta)\gamma$, $\beta_1 = \theta\alpha_1^{-1}(\delta - \alpha_0)$, $\beta_2 = -\theta\alpha_2\alpha_1^{-1}$, $\beta_3 = -\theta\alpha_3\alpha_1^{-1}$, and $\beta_4 = -\theta\alpha_4\alpha_1^{-1}$. Correspondingly, the reduced form employment equation is

$$(10) \quad L = \beta_5 + \beta_6\left(\frac{p}{r_1}\right) + \beta_7\left(\frac{r_2}{r_1}\right) + \beta_8X + \beta_9D$$

where $\beta_5 = \alpha_0 + \theta(\delta - \alpha_0)$, $\beta_6 = \alpha_1\gamma(1 - \theta)$, $\beta_7 = (1 - \theta)\alpha_2$, $\beta_8 = (1 - \theta)\alpha_3$, and $\beta_9 = (1 - \theta)\alpha_4$. Observe that, since $0 < \theta < 1$, $\alpha_3 > 0$ and $\alpha_1 < 0$, these equations imply a positive correlation between wages and employment on the one hand and firm size on the other hand.^{20/} These particular functional form assumptions yield reduced form employment and real wage equations that are homogeneous of degree zero in p , r_1 , and r_2 . By substituting equation (9) and (10) into the union's objective function (7) we derive an expression that relates the maximum value of this function to the exogenous variables of the system:

$$(11) \quad V(p, r_1, r_2, X) = -\left(\frac{\theta}{\alpha_1 p}\right)^{\theta} \left(\frac{1 - \theta}{r_1}\right)^{1 - \theta} [\alpha_1 \gamma p + (\alpha_0 - \delta)r_1 + \alpha_2 r_2 + \alpha_3 X r_1 + \alpha_4 D r_1]$$

which is also, of course, homogeneous of degree zero in p , r_1 , and r_2 .

With the equations of the system described, we turn now to the estimation of the model first with a data set on the ITU in Cincinnati and then with other union locals.

IV. Empirical Results

A. Estimating Methods

The structural parameters of our system were estimated by two procedures. The first exploits the fact that the cost-of-living, p , enters the system through the union's objective function (7), but is excluded from the firm's structural demand equation (8). Thus, using p as an instrumental variable to predict values for (w/r_1) , a conventional instrumental variable procedure was applied to equation (8) which provides

estimates of the α 's. These α 's thus estimated were then imposed in estimating the reduced form wage equation (9) which yields point estimates of the parameters of the union's objective function (namely, θ , γ , and δ). The second estimating procedure involves the simultaneous estimation of the stochastic form of equations (8) and (9) by full information maximum likelihood.^{21/} Conditional upon the specification of the model being correct, this estimator is consistent, asymptotically efficient, and asymptotically normally distributed. In fact, the point estimates derived from applying the two procedures were invariably similar and consequently only the maximum likelihood estimates are reported.

B. The Cincinnati Local

These procedures were first applied to an excellent data set collected for a Cincinnati newspaper, the Post, for the years from 1946 to 1965.^{22/} In estimating the stochastic form of equations (8) and (9), w_t is measured by the hourly wage scale for journeyman printers employed by the Post in year t , L_t by the number of full-time typographical workers in the Post composing room, p_t by the BLS consumer price index, x_t by the amount of advertising linage (in thousands) sold annually by the Post, r_1 by the price of newsprint (in hundreds of dollars per short ton) quoted in national markets, and r_2 by the BLS wholesale price index for machinery and equipment.^{23/} In 1958, the Post merged with one of its two local competitors, the Cincinnati Times-Star and, as a result, a larger and more efficient plant was occupied. ITU members of the Times-

Stars chapel were absorbed into the Post composing room so that the employment of typographers rose from 145 averaged over the years 1946 to 1957 to 232 averaged over the years 1958 to 1965. Thus the merger dummy variable, D , in equations (8) and (9) takes the value of zero from 1946 to 1957 and of unity for the later years. The full information maximum likelihood estimates of the structural parameters of equations (8) and (9) are given in line (a) of Table 1.

With respect to the parameters of the union's objective function, the estimate of θ is significantly less than .5 and greater than 0; the union values both employment and wages. The estimate of γ is significantly greater than zero suggesting that it is not merely the level of wages that matters to the union, but rather the excess of wages over some reference level. In fact, the estimate of γ of around 2.1 ranges from 26 to 47% below the real wage actually received by these workers over these years. By contrast, the point estimate of δ is negative though insignificantly different from zero. According to the estimates in line (a), the elasticity of the maximum value of the union's objective function with respect to wages (.55) is slightly greater than the elasticity with respect to employment (.45) when evaluated at the sample mean values of the variables. The implied elasticity of substitution of wages for employment at this point is .69. Using a conventional likelihood ratio test, the null hypothesis that the nonwage arguments of the labor demand function (namely, r_1 , r_2 , X , and D) are jointly insignificant in the real wage equation (9) may be rejected at the 5% level of significance. These results are consistent with the notion that the union takes account of the employment effects of its wage policy.

Maximum Likelihood Estimates of the Structural Parameters for the Cincinnati Post 1946-65
(estimated asymptotic standard errors in parentheses)

Table 1

line	θ	γ	γ_0	γ_1	δ	δ_0	δ_1	σ_0	σ_1	σ_2	σ_3	σ_4	L
(a)	.215 (.052)	2.134 (.716)			-129.75 (225.36)			204.2 (50.6)	-82.72 (27.30)	1.236 (1.489)	3.472 (2.467)	87.86 (16.16)	-57.20
(b)	.5*	0*			0*			159.1 (72.8)	-75.67 (3.78)	1.018 (1.402)	5.567 (1.513)	60.88 (10.99)	-82.23
(c)	.5*		2.445 (.602)	-.035 (.470)	0*			332.2 (144.4)	-22.66 (23.40)	4.374 (2.350)	2.554 (4.708)	133.22 (28.33)	-64.61
(d)	.054 (.079)		1.456 (.663)	.872 (.363)	-326.92 (860.25)			135.4 (123.2)	-70.21 (20.31)	1.610 (2.363)	3.718 (1.967)	77.95 (21.81)	-52.65
(e)	.490 (.206)		3.965 (2.156)	.491 (.720)		191.31 (49.69)	87.00 (14.93)	201.0 (71.5)	-59.07 (39.59)	-2.268 (1.431)	5.099 (2.634)	77.05 (18.08)	-47.92
(f)	.185 (.059)		1.453 (.377)	.829 (.323)		0*	73.50 (27.27)	147.1 (110.6)	-71.67 (28.17)	1.185 (2.213)	4.855 (1.965)	71.95 (18.02)	-51.27

Note: Constrained parameters are indicated by an asterisk. L denotes the maximum value of the likelihood function. The mean values of the variables over the estimating period are as follows: L = 172.3; w = 2.880; p = .813; r_1 = 1.203; r_2 = 77.485; X = 18.82; and v = 1.378. The typographers wage data are taken from selected issues of the ITU Bulletin and the advertising linage data from April issues of Editor and Publisher. As explained in the text, the employment data were obtained from the research department of Scripps-Howard Newspapers, owners of the Cincinnati Post. Published Bureau of Labor Statistics and Department of Commerce publications provided the sources for p, r_1 , r_2 , and v.

As for the parameters of the labor demand function, the implied wage elasticity of employment ranges from about -1.8 to -1.0 with an elasticity of -1.23 at the mean values of the variables.^{24/} The elasticity of employment with respect to output is estimated at .38 at the mean values of the variables.^{25/} The estimates imply that newsprint and machinery are each substitutes for labor for all observed values of the variables. At sample mean values, the elasticity of the demand for labor with respect to the price of newsprint is estimated to be .77 and that with respect to the price of machinery to be .46.^{26/} The estimated coefficient on the merger dummy ($\hat{\alpha}_4 = 87.9$) is virtually identical to the difference between the average number of typographers employed after the merger and before the merger (namely, 87).^{27/}

At this point, our estimates were contrasted with those corresponding to two popular hypotheses of the objectives of unions. First, under the wage bill maximization hypothesis, $\theta = .5$ and $\gamma = \delta = 0$ and the estimates of the labor demand function fitted under these constraints are given in line (b) of Table 1. A conventional likelihood ratio test finds that the unconstrained estimates in line (a) represent a significant improvement (at the 5% level) over those fitted under the wage bill maximization hypothesis in line (b). Second, a test of the rent maximization hypothesis requires an interpretation of γ as the wage rate that typographers would earn if they were not organized in a trade union. This alternative, non-union, wage rate is not observed, of course, but a plausible specification is that this alternative wage is a linear function of what some existing

non-union workers receive. In particular, suppose that in the absence of the ITU, these workers would earn a linear function of the real average hourly earnings of nonsupervisory workers in the retail trade:

$\gamma = \gamma_0 + \gamma_1(v/p)$.^{28/} With this specification for γ , the rent maximization hypothesis implies the restrictions $\theta = .5$ and $\delta = 0$. The estimates corresponding to this formulation are presented in line (c) of Table 1 with the unconstrained estimates in line (d). A comparison of the values of the likelihood function in lines (c) and (d) results in a rejection (at the 5% level) of the null hypothesis that the unconstrained estimates are no different from those implied by the rent maximization hypothesis. Therefore, the objectives of the ITU at the Cincinnati Post are not adequately described by the maximization of the wage bill nor by the maximization of rents.

The estimates in line (d) of Table 1 correspond to a specification in which γ is a linear function of an alternative real wage rate while δ is a constant. A natural generalization is to permit δ to vary and, upon investigation, it was found that δ appeared to take on a higher value after the 1958 merger which resulted in the ITU members of the Times-Star chapel being absorbed into the Post's composing room. The final two rows of Table 1 augment the specification of $\gamma = \gamma_0 + \gamma_1(v/p)$ with the specification of $\delta = \delta_0 + \delta_1 D$ in line (e). This more general formulation yields the highest point estimate of θ (namely, .490) that we encountered for Cincinnati. However, it is not clear what importance should be attached to this because the implied estimates of γ and δ

are greater than the corresponding mean values of real wages and employment respectively so the objective function is not defined at these values. This particular outcome probably results from too restrictive a specification of the movements in γ and δ , but unfortunately we are handicapped in our investigation of this matter by insufficient degrees of freedom provided by this data set. In general, we found the point estimates of the employment parameter δ to be the most sensitive of the coefficients estimated to slight alterations in the specification of the model.

Estimates that are more consonant with the Stone-Geary specification are given in line (f) of Table 1, but they are obtained only after arbitrarily restricting the parameter δ_0 to a value of zero. According to the results in line (f), the elasticity of substitution between real wages and employment in the union's objective function is .305 at sample mean values of the variables. The elasticity of the maximum value of the union's objective function with respect to wages (.97) is virtually identical to the elasticity with respect to employment (.98). The estimate of γ_1 is consistent with the hypothesis that the ITU's reference wage, γ , rises dollar-for-dollar with increases in the wages of non-union workers in retail trade. The merger raises δ by almost exactly the amount by which the merger shifts the labor demand function (as given by α_4). At sample mean values, the elasticity of employment with respect to wages is -1.00, that with respect to output is .53, that with respect to the price of newsprint is .55, and that with respect to the price of machinery is .44.

Finally, to illustrate the use of the union's indirect objective function equation (11), we formed the index V_t/V_0 where V_0 and V_t

indicate the values of the indirect objective function in the year 1946 and in each subsequent year t respectively. This ratio, V_t/V_0 , may be interpreted as an index number of the union's objective function given the observed values of p , r_1 , r_2 , and X in year t relative to its value in the base year 1946. Calculating this welfare index with the parameter estimates from line (f) of Table 1 yields the following results:

year	1946	1950	1954	1958	1962	1965
V_t/V_0	1.00	1.46	1.50	1.57	1.55	1.76

which registers a 76% increase in the union's welfare over this period. By contrast, the real wages of these typographers rose by 41% between 1946 and 1965 while employment grew 118%.

C. Other Union Locals

To examine the generality of this framework of union behavior, data for the 1946-65 period were collected for seven other local chapters of the ITU. Unlike the data for the Cincinnati Post, observations on firm employment are not readily available so that for these seven locals we used data on local union membership instead.^{29/} The resulting seven union locals range in size from Fond du Lac, Wisconsin, with a mean journeyman membership of 41 over the 1946-65 period to the Columbus union with average membership of over 600. In each city but one, the wage and advertising linage variables relate to the single newspaper firm in the city.^{30/} The stochastic forms of equations (8) and (9) were fitted to

the time series data for each of the seven unions with estimates given in Table 2.

As far as the union's objective function parameters are concerned, first observe that the estimates of γ are greater than the mean values of real wages for Elmira and Fond du Lac and the estimates of δ exceed the mean values of employment for Augusta, Elmira, and Fond du Lac. As was the case for the estimates for Cincinnati in line (e) of Table 1, this is a consequence (we surmise) of not accounting adequately for movements in the reference levels, γ and δ .^{31/} For the other four unions, the estimates of γ are significantly greater than zero in all cases while for only Columbus would the estimate of δ be evaluated as greater than zero at conventional levels of significance. The point estimates of θ range from .15 in Dubuque to .79 in Columbia. Except for Dubuque, the estimates of θ are significantly greater than zero and smaller than unity.^{32/} Comparing the results for Columbia, Columbus, Dubuque, and Memphis, the tendency is for the estimates of the "reference" parameters, γ and δ , to be greater for the larger unions. These larger unions are located in bigger cities where opportunities for alternative employment (especially in commercial printing) are greater and where wage levels are higher. In particular, the significance of γ suggests that the union's wage policy is determined with reference to some alternative or comparison wage rate and models that ignore this aspect of union behavior are neglecting what appears to be a consistent finding in this study. In this regard, using a likelihood ratio test, we are able to reject (at even the 1% level)

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Union Local	Mean Real Wage	Mean Union Membership	θ	γ	δ	α_0	α_1	σ^2	c_3	η_4	L	η_w	η_x	η_r
Augusta, Ga.	2.96	56	.584 (.045)	2.268 (.626)	75.95 (28.63)	-41.02 (56.75)	-83.05 (15.50)	3.421 (1.045)	4.152 (1.086)		-24.56 (.55)	-2.97 (.55)	1.65 (.38)	2.65 (1.17)
Columbia, S.C.	2.93	105	.787 (.054)	1.891 (.724)	22.46 (31.06)	42.73 (90.12)	-173.91 (15.22)	4.601 (1.528)	3.643 (.829)		-18.53 (.30)	-3.41 (.30)	.82 (.13)	2.67 (.97)
Columbus, Ohio	3.58	602	.312 (.075)	3.457 (.692)	580.24 (141.85)	264.45 (187.80)	-133.58 (44.46)	3.760 (3.099)	7.805 (1.319)	63.58 (27.16)	-63.95 (.18)	-.54 (.18)	.66 (.11)	.40 (.35)
Dubuque, Iowa	2.73	68	.151 (.269)	1.455 (.650)	24.89 (26.48)	22.54 (21.59)	-8.92 (18.99)	.356 (.402)	4.136 (.833)	3.99 (2.01)	-14.63 (.52)	-.25 (.52)	.57 (.11)	.35 (.37)
Elmira, N.Y.	3.15	120	.819 (.037)	4.264 (.925)	171.17 (36.56)	-230.09 (202.69)	-311.99 (16.57)	16.232 (3.706)	1.703 (3.699)		-52.02 (.30)	-5.59 (.30)	.23 (.50)	8.76 (2.05)
Fond du Lac, Misc.	2.96	41	.866 (.062)	11.486 (5.680)	76.53 (7.41)	-75.59 (33.77)	-38.03 (6.56)	2.196 (.521)	7.146 (1.876)		-18.54 (.33)	-1.93 (.33)	1.35 (.35)	3.46 (.81)
Memphis, Tenn.	3.46	323	.315 (.072)	2.943 (.749)	226.36 (153.64)	-285.63 (92.86)	-120.24 (30.45)	10.799 (1.846)	5.136 (1.490)		-62.08 (.28)	-.94 (.28)	.68 (.20)	2.15 (.37)

Note: Columbus and Dubuque are the two cities where important newspaper mergers occurred during the estimating period. L denotes the logarithm of the likelihood function evaluated at its maximum. The implied elasticity of employment with respect to wage rates is given by η_w , the implied elasticity of employment with respect to output is given by η_x , and the implied elasticity of employment with respect to the price of machinery and equipment is given by η_r . Each of these elasticities is evaluated at the sample mean values of the variables for each union.

for all of the unions the hypothesis that the unconstrained estimates are no different from those implied by the wage bill maximization hypothesis (under which $\theta = .5$ and $\gamma = \delta = 0$).

The estimates of the parameters of the labor demand function are probably best understood in terms of their implications for the elasticity of demand for labor which are given in the final three columns of Table 2. The wage elasticities evaluated at the sample mean values of the variables for each union (so the point of evaluation differs across unions) range from -5.59 for Elmira to -.25 for Dubuque although the standard errors attached to these estimates caution against confident inferences: clearly a wide range of elasticities is compatible with the data.

V. Conclusions

The purpose of this paper is to report the consequences of an empirical analysis of a well-known model of union behavior. In general, our results indicate that the ITU's objectives cannot be identified with wage rates or with employment alone, but that both are arguments of a more general objective function. Our estimates accord with those models in which the union is characterized as setting its decision variables with reference to some norm since it appears to be the excess of wages and employment over some reference levels that is relevant to union behavior. However, the relative weight attached to supernumerary wages versus supernumerary employment varies considerably across unions. The wage bill maximization hypothesis that ignores these reference levels has been

found in every case to provide an inferior explanation of movements in wages and employment compared with our more general formulation. Nevertheless, in some cases, our more general specification is insufficiently general, but the opportunity to relax the restrictions on the reference level parameters, γ and δ , is severely limited by the available number of observations on each union. It should also be emphasized that an evaluation of the empirical performance of this model tacitly involves joint tests on the specification of the union's objective function and of the labor demand function since expressions are required for both functions in order that a model of this kind be implemented.

There are two particularly important areas of union behavior where the model described in this paper is inadequate. The first concerns the various job security provisions in many union contracts which, if effective and binding, should be modelled explicitly. Of course, although they exist in many collective bargaining contracts, the extent to which the employer can evade their constraints has not been determined in other than a few instances.^{33/} The second area that requires more research concerns the intertemporal aspect of the model: clearly the objectives of unions are defined over the future values of variables as well as their current values while the employer's immediate response to a negotiated settlement may well differ from his longer term response. Any serious attempt to model trade union behavior must eventually come to grips with these issues. What has been described in this paper is only an initial step towards that more satisfactory model.

Footnotes

- 1/ This opinion differs from the one widely held that, as expressed by Reder (1952), "...the behavior of firms and consumers can be easily interpreted as 'maximizing' while that of a union cannot" (p. 34).
- 2/ See Lipset, Trow and Coleman (1967).
- 3/ Lipset, Trow, and Coleman (1956) write, "...all of the members of the ITU share a roughly common income and status...The ITU is thus, insofar as this is possible, a community of equals, and there is consequently no 'underprivileged' group in the unions...all subskills contribute roughly equal proportions of active leaders and one finds no tendency for a high-status group to monopolize and dominate internal politics." (pp. 142-143).
- 4/ Most recently, the ITU has resisted the adoption of new technology which permits electronic and computerized composition of newspaper product except in cases where jurisdiction over new skills and maintenance of employment is permitted. See Kelber and Schlesinger (1967).
- 5/ This philosophy of "work sharing" probably reached a zenith during the Great Depression when a national convention adopted a referendum vote approving a law directing all situation holders to put a substitute on work at least one day per week.
- 6/ In their survey of the New York local, Lipset, Trow, and Coleman (1956) report, "A significant minority of the union's members, 17%, are the sons of printers, while 30% have relatives other than a father in the occupation. Many of the leaders of the ITU are recruited from the ranks of printer families" (p. 206).
- 7/ This information is taken from Editor and Publisher (the industry's weekly magazine), 23rd February 1946, p. 76.
- 8/ See Reder (1952), p. 39.
- 9/ Therefore, it involves not too drastic an assumption if the costs of negotiation and the role of strikes which sometimes figure in models of union behavior (see Atherton (1973) and Mitchell (1972)) are neglected in this study.
- 10/ The problems involved in aggregating over preferences are discussed in Becker (1974) and Samuelson (1956). A rationalization of equation (1) in terms of a "... union as a political institution run by a bureaucracy whose goals are not necessarily identical with those of the membership" appears in Kotowitz and Portes (1974).

11/ Our assumption with the newspaper firms below is that their output is determined primarily by the demographic characteristics of the local media market which are exogenous to a single firm. In fact, we investigate below the possibility that output should be treated as endogenous. Also see Rosse (1970) and Dertouzos (1979).

12/ As is well known, this tangency solution between the union's indifference curve and the slope of the firm's labor demand function does not lie on the contract curve. (See, for example, Leontief (1946) or Fellner (1947).) This feature may be unrealistic in some employer-union settings, but it is not clear that it is so for typographers. The second-order condition concerns the relative rates at which the union's isoquant and the employer's labor demand function are changing:

$$p^{-2}g_{11} + 2p^{-1}g_{12}\frac{\partial f}{\partial w} + g_2\frac{\partial^2 f}{\partial w^2} + g_{22}\left(\frac{\partial f}{\partial w}\right)^2 < 0 .$$

13/ The sort of restrictions on equations (1) and (2) that generate refutable sign implications may be illustrated as follows. If equation (1) is strongly separable in wages and employment (or, less restrictively, if $g_{12} \geq 0$), if labor is not an inferior factor, and if an increase in output does not reduce the slope of the labor demand function (i.e., if $\partial^2 f / \partial w \partial X > 0$), then an increase in output or an increase in the price of a substitute input results in a higher optimal money wage rate.

14/ Also $(\partial V / \partial r_i) / (\partial V / \partial X) = (\partial f / \partial r_i) / (\partial f / \partial X)$.

15/ Clearly, with γ and δ equal to zero, a value of θ of 1 yields an objective function that consists simply of the wage rate (a model of union goals sometimes attributed to Henry Simons (1944)) while a value of θ of 0 implies that only employment matters.

16/ Cf. "...[T]he bargaining process is almost always directed toward an upward or downward change in a preexisting wage rate and the greatest interest often centers on the magnitude of the change," Ross (1948, p. 46). Formally, this particular extension of the Stone-Geary was proposed and analyzed by Stone (1956) and Pollak (1970).

17/ The importance of such comparisons in affecting the goals of trade unions has been stressed by Ross (1948). Again, formally it involves a similar sort of extension of the Stone-Geary function as that analyzed by Pollak (1976).

- 18/ Almost 8% of all cities with daily newspapers had more than one newspaper in 1948. By 1968 this had fallen to less than 3%. See Dertouzos (1979). The effect of a newspaper merger on union preferences was also investigated and the results are reported below.
- 19/ More information on the newspaper production technology is contained in Rosse (1970, 1977). Also estimated with the Cincinnati data were labor demand functions whose slopes as well as whose intercept changed with a merger, but the results did not differ materially from those reported below.
- 20/ For evidence on the association between wages and firm size in the newspaper industry, see Dertouzos (1979).
- 21/ In particular, we employed the Berndt, Hall, Hall and Hausman (1974) computational procedure.
- 22/ One of us in the course of performing consulting activities for the Cincinnati Post obtained employment data normally not available through public sources.
- 23/ In some estimates, the machinery price index was replaced by a measure of the user cost of capital, but the results were essentially unchanged.
- 24/ It is not straightforward to compare these estimates of labor demand elasticities with others in the literature since these relate to a small group of workers in a single firm while previous estimates have been at a much higher level of aggregation.
- 25/ The assumption that output is exogenous in these equations was considered. For instance, errors in measuring output may arise because our index of newspaper output, namely, advertising linage ignores dimensions of output such as quality and the space devoted to news. For this reason, some instrumental variable estimates were derived where the instruments for newspaper output consisted of the city-zone household population per year, aggregate U.S. advertising expenditures per household in real dollars, and the share of aggregate advertising expenditures earned by television. Clearly, these variables are exogenous to the individual newspaper firm. The resulting estimates of the parameters of the labor demand function were very similar to those in line (a) of Table 1.
- 26/ This finding that newsprint and typographers are substitute inputs is consistent with the stylized facts in the newspaper industry. For as the relative price of newsprint rose, firms found it optimal to conserve on newsprint by producing zoned editions of newspapers and typographers were required to compose advertising copy for each edition's separate sections.

- 27/ Augmenting the labor demand function with a linear time trend variable produces similar results to those reported in line (a) while the estimated coefficient on the trend variable is about one-quarter its estimated standard error. To be specific, the maximum likelihood estimates of this system are as follows (with estimated standard errors in parentheses): $\theta = .201 (.053)$; $\gamma = 2.126 (.880)$; $\delta = -130.02 (283.58)$; $\alpha_0 = 196.4 (91.8)$; $\alpha_1 = -80.99 (27.59)$; $\alpha_2 = 1.087 (1.451)$; $\alpha_3 = 3.315 (2.653)$; $\alpha_4 = 85.14 (15.89)$; and with the estimated coefficient on the time trend variable .290 (1.302).
- 28/ To forestall any confusion, the assumption here is not that, if they were not unionized, these typographers would be workers in retail trade. The assumption is if the typographers were not unionized and remained typographers, their wage over time would be some proportion of what non-union workers in retail trade receive. The v series used relates to the United States as a whole. An hourly earnings series for nonsupervisory workers in the retail trade in Ohio is available only after 1952 and in Cincinnati after 1957. However, for the years from 1953 to 1966, the Ohio series and the U.S. series move very closely together.
- 29/ Data on local union membership may be obtained from the union's publication Typographical Journal. These union membership data include those employed in commercial printing establishments as well as those in newspaper firms. We were obliged to use the union membership data although to minimize measurement problems large cities with substantial printing industries (such as New York and Chicago) were excluded from our analysis. For most union locals, commercial printing employment constitutes a very small fraction of the membership.
- 30/ Columbus is the single exception: in this city the data are aggregated over several newspaper firms. We follow Rosse (1978) in treating agency shop newspapers (i.e., "enterprises with separately owned and produced editorial products but with joint mechanical production and joint sale of advertising and subscriptions..." in the same city (p. 3)) as a single firm.
- 31/ On occasions, permitting the reference levels γ and δ to vary resulted in a likelihood function with no pronounced maximum.
- 32/ Evaluated at each union's sample mean values, the elasticity of substitution between wages and employment in the union's objective function is estimated at .70 for Columbia, .04 for Columbus; .49 for Dubuque, and .20 for Memphis.

- 33/ One instance is Hartman's (1969) excellent study of the effects of the mechanization and modernization agreement in the Pacific Coast long-shoring industry. His analysis suggests that those work rules which took the form of specifying fixed quantities of labor input were essentially evaded by the employers by an appropriate arrangement of the flow of work. On the other hand, those work rules that governed the mix of machinery to labor did appear to affect employment and productivity.

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