THE TRADE-OFF BETWEEN WAGES AND EMPLOYMENT
IN TRADE UNION OBJECTIVES

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ABSTRACT

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This paper demonstrates that, contrary to a widely-held opinion, the determination of the goals of unions is fully amenable to empirical analysis. A characterization of the wage and employment-setting process in unionized markets is adopted and its qualitative implications examined. The first-order condition for this model is fitted to time-series data on the newspaper industry from ten cities. The International Typographical Union's objective function reveals very restricted opportunities for substituting wages for employment in response to a change in the slope of the employer's labor demand function. Larger union locals place greater emphasis on wages versus employment than smaller union locals.

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I. Introduction

There is now a considerable volume of evidence to suggest that
unionized labor markets operate differently in a number of respects from
non-unionized labor markets. However, in general, these findings have
been reported with little attempt to relate these empirical regularities
to the objectives of and constraints on the decision-making units
involved. Consequently, our understanding of "what may trade unions
maximize?" has advanced only a trifle from the time that John Dunlop
[1944] first raised the question almost 40 years ago. The prevailing
opinion appears to be that the problem of modelling trade union behavior
is "virtually intractable" [Johnson, 1975]. The purpose of this paper
is to belie this notion. We adopt a characterization similar to
Dunlop's for the determination of wages and employment in unionized
markets and we apply this model to a particular institutional setting.
Our objective is not to endorse the specific model of the trade union
outlined here, but simply to demonstrate that the investigation of union
goals is fully amenable to empirical analysis.

The data examined here describe the wages and employment of
members of the International Typographical Union for ten cities over the
20 years from 1946 to 1965. This is a truly extraordinary union whose
features are well suited to the particular model outlined. Before the
dramatic technological changes of the last 15 years, the union occupied
a very powerful bargaining position with newspaper firms and, therefore,
there is good reason for interpreting the movements of wages and employ-
ment of these typographers as reflecting the constrained objectives of

the union. This represents a maintained hypothesis in this paper and, while some observers of this institutional setting may question this judgement, it is not evident that the sort of abstraction involved here is any more demanding of empirical phenomena than are the economist's conventional models of the firm or of the family. Moreover, good reason exists for investigating the role of the ITU in view of the unsatisfactory state of our understanding of the pattern of wages in the printing industry which is based on research that has avoided explicit modelling of the behavior of the union. For instance, in the literature that seeks an explanation for the movement in money wage rates over time, the sort of multiple regression equation that is preferred for most industries always performs lamentably for the printing industry.[1] In addition, the variation in the wage rates of typographers across cities is much greater than the typical geographical differentials for a given occupation and this has never been satisfactorily accounted for.[2] Naturally one is led to wonder whether a better understanding of the union would provide the key to an explanation of these features of the printing industry.

In this paper the union is characterized as maximizing an objective function that contains wage rates and employment as arguments and as being constrained by a trade-off between these two variables given by the employer's labor demand function. This model which offers a determinate solution to union-management bargaining was articulated most fully by William Fellner [1947] and Allan Cartter [1959]. As a theory of the determination of wages and employment in unionized markets, it is

clearly deficient in not explaining how a position of disagreement at the opening of the collective bargaining process converges over time into a mutually acceptable contract. Moreover, as Leontief [1946] and Fellner [1947] made clear, the solution to the bargaining process provided by this model lies inside the payoff frontier and thus it is an inefficient contract from the point of view of the two parties involved. However, the standard of efficiency used here is one that presumes the absence of transactions costs to negotiating an agreement and the empirical relevance of this standard for a union-management bargaining situation should not be taken for granted. That is, it is not evident that collective bargaining procedures provide incentives for the parties to reveal their respective valuations and, in fact, each party's objective function tends to be camouflaged by a veil of threats, bluffs, and deceptions. In such circumstances when each party's perception of its opponent's payoff function is distorted, there is no guarantee that the Pareto frontier (defined as excluding these negotiation costs) will be reached and so there seems no compelling reason either to presume that union-management contracts are efficient in this sense or to presume that they are not.

This Fellner-Cartter model is outlined in the following section and, since there has been little attention addressed to the issue, the qualitative implications of the model are discussed. Section III presents a brief description of the ITU and the American newspaper industry and of the data used in this study. Estimates of the objective functions of the ITU locals are presented in Section IV.

II. Conceptual Framework

Our starting point is a firm that hires labor and n other inputs at given prices to produce an output at minimum cost. The cost function summarizing this behavior is

$$C = C(w,r_1,r_2,\ldots,r_n,X) = C(w,r,X) \quad,$$

where w is the wage rate, r_i the price of input i, and X the level of output. C is assumed to be smooth and fully differentiable and is a linearly homogeneous concave function of all input prices. The cost-minimizing level of employment, L, is determined from the cost function by simple differentiation:

$$(1) \qquad L(w,r,X) = \frac{\partial C(w,r,X)}{\partial w} \equiv C_w \quad.$$

The workers are organized in a trade union whose leader takes account of the welfare of all its members as represented by the following quasi-concave objective function:

$$(2) \qquad U = g(w,L,Y)$$

where U is assumed to be strictly increasing in the wage rate (w) and in employment (L). Variables that affect union preferences, but are exogenous to the union are indexed by Y. These might include the price level of commodities consumed by union members, the wage received by a comparison group of workers, or the level of unemployment benefits. This objective function, equation (2), includes as special cases the

wage bill as proposed by Dunlop, rents from unionization as proposed by de Menil [1971] and Rosen [1970], and expected per member utility as proposed by Farber [1978], McDonald and Solow [1981], and Oswald [1982].

The union selects w and L to maximize its objective function, equation (2), subject to the choice of w and L being restricted by the employer's labor demand function, equation (1). The situation in which the union determines the wage rate and then leaves the employer to determine employment through equation (1) is, of course, consistent with this model. The first-order condition for a maximum is

$$(3) \qquad \frac{g_1}{g_2} = - \frac{\partial C_w(w,r,X)}{\partial w} \equiv s(w,r,X) \quad ,$$

where $g_1 \equiv \partial U/\partial w > 0$ and $g_2 \equiv \partial U/\partial L > 0$ or the marginal rate of substitution of wages for employment in the union's objective function equals the slope (s) of the firm's labor demand function. The second-order condition for a maximum may be written as

$$(4) \qquad \Delta = -\sigma^{-1} w^{-1} g_1 (swL^{-1} + 1) - g_2 s_w \quad ,$$

where $s_w = \partial s/\partial w$, swL^{-1} is the wage elasticity of the firm's labor demand function, and σ is the elasticity of substitution between wages and employment in the union's objective function. The reduced form equations may be derived from equations (1) and (3) and they express wage rates and employment as functions of all the exogenous variables:

$$(5) \qquad w = \phi_1(Y,r,X) \quad ;$$

(6)
$$L = \phi_2(Y,r,X) \ .$$

These reduced form equations and the marginal rate of substitution equation (3) are invariant under positive monotonic transformations of the union's objective function.

The qualitative content of this model of unionism is assessed by determining the signs of the partial derivatives of equations (5) and (6). In fact, without specifying particular expressions for the objective and constraint functions, all that can be said about the signs of these derivatives is that the sign of $\partial L/\partial Y$ must be opposite that of $\partial w/\partial Y$: an increase in Y alters the objective function, but does not disturb the constraint C_w so if the union opts for an increase in wage rates then this must be accompanied by a decrease in employment. Other than this restriction across equations (5) and (6), the sign of each of the partial derivatives is ambiguous and in this sense the model is empty of qualitative implications.[3/] This is not surprising in view of the theorem of conjugate pairs [Archibald, 1965], but it is odd that a model with so little qualitative content should have provoked such an extensive debate as that which arose over whether or not the trade union can be portrayed as maximizing anything.[4/]

The dual of this problem describes the union as selecting w and L to minimize the parameters of the labor demand function $C_w = L(w,r,X)$ subject to a prescribed value of the objective function $U^0 \geq g(w,L,Y)$. Naturally, the first-order condition for this problem is again given by equation (3) which may be solved jointly with the

constraint to yield "utility-constant" reduced form equations for wages and employment:

$$w = \psi_1(Y,r,X,U^0)$$

$$L = \psi_2(Y,r,X,U^0) \quad .$$

The derivatives of these equations can be related to those of equations (5) and (6) in Slutsky-type fashion, but, unless further restrictions are placed on the objective function or on the constraint function, the "utility-constant" derivatives (such as $\partial\psi_1/\partial Y$ and $\partial\psi_1/\partial X$) cannot be signed.

Instead of dwelling on the dearth of qualitative statements that can be made, consider what restrictions on the model will yield unambiguous implications. For instance, suppose labor is not an inferior input (so $\partial C_w/\partial X > 0$) and suppose that the union's objective function is strongly separable in wages and employment (so $g_{12} = 0$). Then, provided an increase in output does not increase the slope of the labor demand function with respect to wage rates (that is, provided $s_X \leq 0$), an increase in output will induce an increase in the optimal wage rate. On the corresponding set of assumptions, an increase in the price of an input that is a substitute for labor will induce an increase in the optimal wage rate. In these two cases, whether or not optimal employment also increases depends upon the magnitude of the slope of the labor demand function with respect to wages. Alternatively, suppose the union maximizes the total rents from unionization. Once again, if labor

is not an inferior input and provided an increase in output does not increase the slope of the labor demand function, then an increase in output will induce an increase in the optimal wage rate. However, so little is known about the nature of the union's preferences for wages and employment that we are in no position to assess the empirical relevance of alternative prior restrictions on the union's objective function. For example, Cartter's [1959] conjecture that the elasticity of substitution between wages and employment in the union's objective function is very low[5/] has never been confronted with the evidence although the limiting case of this hypothesis--that wages and employment are combined in fixed proportions--would considerably simplify models of unionized labor markets.

III. The Institutional Background and the Data

The data used to estimate the union's objective function consist of annual observations on wages, employment, and other variables describing the members of the International Typographical Union and the newspaper industry in ten American cities from 1946 to 1965. The ITU is the quintessential democratic union where the leaders exercise very little discretionary authority, where the perquisites of being an official are few, where the rank-and-file are intimately involved in the management of the union, and where there are no important skill differentials within the union.[6/] Consequently, an objective function such as equation (2) that does not differentiate between the interests of the leadership and of the rank-and-file or between various groups within the

rank-and-file is well suited to the ITU. Moreover, it is evident from
the ITU's well-known concern for the employment effects of new tech-
nology that the employment of its members occupied a very important
place in its objectives. On the other hand, the popular portrayal of
the union as relentlessly opposing new composing methods is something of
a caricature. There have been occasions on which the union has spon-
sored inventions and it established its own research and development
laboratory and staff in the 1950s. The more accurate description is
that the ITU adapted to and controlled the new technology up until the
mid-1960s.[7/] In the period before the dramatic technological changes
that have taken place in the newpaper industry in the last fifteen years
or so, the ITU had clearly established a dominant bargaining relation-
ship with the employers: collective bargaining took place at the local
level where the ITU operated a closed shop requiring every worker in the
composing room, including the foreman, to be a member of the union.
Newspapers were extremely vulnerable to an interruption in production
and, in fact, for the ten union locals in the years analyzed below, no
strikes took place. The ITU was a highly sophisticated union and very
mindful of the competitive environment in which newspapers operated.
Wage increases not matched by increases in productivity would translate
into newspaper price and advertising rate increases that, other things
equal, would harm the newspaper's total revenue and ultimately dis-
courage ITU employment.

The data most appropriate for a study of this kind describe the production processes of a particular newspaper and, in fact, such data have been obtained for the Cincinnati Post.[8/] For Cincinnati, w stands for the hourly wage for journeymen printers at the Post and L is the number of full-time typographical workers in the Post composing room. In 1958, the Post merged with the Cincinnati Times-Star and the ITU members of the Times-Star chapel were absorbed into the Post composing room. The primary problem presented by extending the study to other cities is the difficulty of obtaining employment data. The Typographical Journal, the union's publication, supplies data on local union membership, but these figures will include ITU members employed in commercial (book and job) printing establishments. Typically, major book and job establishments are located in very large cities so, if we avoid these cities, a much closer correspondence between local union membership and newspaper employment is reached. Therefore, for nine other cities, the data on L represent local union membership.

Average values of w and L over the years 1946-65 for the ten cities are given in Table I together with other characteristics of these cities. The cities range from Columbus, Ohio, that had a mean journeyman membership of just over 600 in these years to Fond du Lac, Wisconsin, which was about one-fifteenth the size of Columbus. Average money wages ranged from a high of $2.94 in Columbus to $2.17 in Dubuque. In fact, the wages of typographers vary markedly across all cities in the United States and a thorough explanation for these differentials has yet to be provided. For the ten cities listed in Table I

Table I

Mean Values of Variables for Ten Cities
Averaged Over the Years 1946-1965

		w	w/p	L	X	1960 population
1	Cincinnati[m], OH	2.88	3.51	172	18.8	503
2	Augusta, GA	2.35	2.96	56	19.5	71
3	Columbia, SC	2.42	2.99	105	23.6	97
4	Dubuque[m], IO	2.17	2.73	68	9.3	57
5	Memphis, TN	2.84	3.46	323	42.5	498
6	Fond du Lac, WI	2.41	2.96	41	7.8	33
7	Louisville, KY	2.89	3.44	397	43.7	391
8	Elmira, NY	2.63	3.15	120	16.3	47
9	Columbus[m], OH	2.94	3.58	602	51.0	471
10	Albany[m], NY	2.78	3.38	596	30.8	130
	All ten cities pooled	2.65	3.24	262	27.1	230

Notes: The superscript "m" following four of the cities identifies those cities in which a newspaper merger took place between newspapers during these years. The average hourly wage scale for journeymen is given by w and w/p is w deflated by the consumer price index. L denotes employment at the Post for Cincinnati and it represents local union membership for the other cities. The data on w are from issues of the ITU Bulletin while union membership data come from the Typographical Journal. The Post's advertising linage (in thousands) in April is listed in the column headed X while for the other cities X is total linage sold by all the local daily newspapers. This information on X comes from issues of Editor and Publisher, a trade magazine. A rough index of potential readership is provided by the numbers on the population (in thousands) of each city in 1960. These population figures are taken from Table 30 of the 1960 Census of Population, Vol 1, Characteristics of the Population, Part 1, U.S. Summary.

over these years, there were strong positive trends in both real wages and employment, but virtually no cyclical movements in these variables, a finding consistent with the belief that unionism tends to insulate these labor market variables from cyclical movements in economic activity.

IV. Empirical Results

One way of implementing the model of unionism outlined above is to posit particular functional forms for the union's objective function, equation (2), and for the firm's labor demand function, equation (1), and then to estimate the implied reduced form equations for wages and employment, equations (5) and (6). This procedure has been applied in previous work[9] and it possesses the attractive feature of permitting simulation exercises on the reduced form equations. On the other hand, the closed form solution of the reduced form system can be obtained only if relatively simple expressions are specified for the union's objective function and for the labor demand function. Hence, if we limit ourselves to reduced form estimation, then this rules out some interesting general forms for the objective and constraint equations. Consequently, a different course is pursued here, one of estimating the marginal rate of substitution equation (3). This has the computational advantage of requiring nothing more than standard two-stage least-squares.

Suppose the union's objective function takes the following form where p denotes the consumer price index, a measure of the price level of consumer goods purchased by union workers:

(7) $\qquad U(\frac{w}{p},L) = \mu(1 + \lambda)^{-1} \left[(\frac{w}{p} - \gamma)^{1+\lambda} - 1 \right] + (1 - \mu)(1 + \eta)^{-1}(L^{1+\eta} - 1)$

$\qquad\qquad = k + \mu(1 + \lambda)^{-1}(\frac{w}{p} - \gamma)^{1+\lambda} + (1 - \mu)(1 + \eta)^{-1}L^{1+\eta}$

where $\quad k = - [\mu(1 + \lambda)^{-1} + (1 - \mu)(1 + \eta)^{-1}] \qquad$ and where $\quad 0 < \mu < 1$
and $w/p > \gamma$. This objective function is quasi-concave if the following
expression is negative:

(8) $\qquad \mu(1 - \mu)(\frac{w}{p} - \gamma)^{\lambda-1}L^{\eta-1}[\lambda(1 - \mu)L^{\eta-1} + \eta\mu(\frac{w}{p} - \gamma)^{\lambda-1}] \quad ,$

a sufficient (but not necessary) condition for which being that both λ
and η are negative. This strongly separable function, equation (7),
is the addilog augmented by the parameter γ that provides a reference
point for real wages. This function has the appealing feature of nest-
ing some interesting special cases. For instance, consider
$\lambda = \eta \rightarrow -1$. Then the objective function may be written as follows:

$\qquad\qquad U(\frac{w}{p},L) = \mu \log (\frac{w}{p} - \gamma) + (1 - \mu) \log L \quad ,$

and if, futhermore, $\mu = 0.5$ and γ equals the competitive real wage,
then this objective function is a transformation of the rents from
unionization, an objective discussed by Dunlop [1944], Rosen [1970], and
de Menil [1971]. If $\lambda = \eta \rightarrow -1$, $\mu = 0.5$ and $\gamma = 0$, the objective
function is a transformation of Dunlop's wage bill maximand. Or if
$\gamma = 0$ and $\lambda = \eta \neq -1$, the objective function is a transformation of

the constant-elasticity-of-substitution function, but otherwise the elasticity of substitution (σ) between wages and employment in the union's objective function is not constant and, in particular, σ is given by the following expression:

$$\sigma = - \left[\frac{\mu(\frac{w}{p} - \gamma)^{\lambda}(\frac{w}{p}) + (1 - \mu)L^{1+\eta}}{\lambda(1 - \mu)(\frac{w}{p} - \gamma)^{-1}(\frac{w}{p})L^{1+\eta} + \eta\mu(\frac{w}{p} - \gamma)^{\lambda}(\frac{w}{p})} \right] .$$

Clearly, unless the parameters assume the particular values discussed above, the union's preferences for wages vis-à-vis employment cannot be described fully by a single parameter and the value of the substitution elasticity depends on the particular combination of wages and employment being evaluated.

With this augmented addilog objective function, the natural logarithm of the marginal rate of substitution equation (3) is as follows:

$$\lambda \log (\frac{w}{p} - \gamma) + \log (\frac{\mu}{1 - \mu}) - \log p - \eta \log L = \log s$$

where, as before, s is the slope of the firm's labor demand function. The empirical implementation of this equation requires an expression for the slope of the labor demand function and this has been assumed to be $s = e^{\alpha X}/r$ where X indexes output[10] and r denotes the price of newsprint (in hundreds of dollars per short ton) as quoted in national markets. Newsprint is a very important input into newspaper production and previous work indicated that the ratio of wages to the price of newsprint exercised a highly significant influence upon typographer

employment. The specification here builds upon this finding by allowing the slope of the labor demand function to depend upon output (X) as well. Integration will reveal that very general labor demand functions and cost functions (including cost functions exhibiting decreasing or constant or increasing returns to scale) are consistent with this expression for s.[11] In addition, the reference parameter for real wages (γ) is specified not as a fixed constant but as a constant proportion of the real wages of another group of workers, say, $\gamma = \beta(w^a/p)$, a popular special case of this being $\beta = 1$. With these assumptions concerning s and γ, the previous equation may be written

$$(9) \quad \log\left(\frac{w}{p}\right) = \log\left\{\beta\left(\frac{w^a}{p}\right) + \exp\left[\frac{1}{\lambda}\log\left(\frac{1-\mu}{\mu}\right) + \frac{1}{\lambda}\log\left(\frac{p}{r}\right) + \frac{n}{\lambda}\log L + \frac{\alpha}{\lambda}X\right]\right\}$$

and, after a stochastic error term is added to the right-hand side, this equation may be fitted by nonlinear two-stage least-squares methods [Amemiya, 1974] where employment is treated as endogenous.[12]

Table II presents the results from fitting equation (9) to the pooled 182 observations on all ten union locals together. To serve as a reference wage series (w^a), both the average hourly earnings of non-supervisory workers in retail trade (who are almost wholly non-unionized) and the average hourly earnings of production workers in manufacturing industry were used. These two wage series move together over the years from 1946 to 1965 so there is little difference between

Table II

Estimates of the Marginal Rate of Substitution Equation (9)
(standard errors in parentheses)

Line	β	μ	λ	η	α	σ	see
(i)	1.257 (0.081)	0.195 (0.054)	-0.994 (0.210)	-0.227 (0.065)	0.001 (0.003)	0.361 (0.085)	0.061
(ii)	1.290 (0.132)	0.111 (0.051)	-0.591 (0.173)	-0.415 (0.117)	0.015 (0.006)	0.580 (0.148)	0.468
(iii)	1.300 (0.117)	0.337 (0.180)	-0.838 (0.211)	-0.111 (0.191)	0.001 (0.003)	0.402 (0.061)	0.040
(iv)	0.774 (0.437)	0.356 (1.163)	-4.624 (10.365)	-0.163 (1.288)	-0.086 (0.255)	0.131 (0.286)	0.137
(v)	1.061 (0.175)	0.709 (0.417)	-2.406 (0.940)	0.063 (0.514)	-0.020 (0.011)	0.191 (0.061)	0.031
(vi)	1.525 (0.205)	0.513 (0.286)	-0.311 (0.284)	0.157 (0.293)	0.001 (0.005)	0.707 (0.330)	0.041

Notes: The standard error of the regression is given by "see." The mean and standard deviation of $\log(w/p)$ over all observations are 1.165 and 0.145 respectively. The mean and standard deviation of $\log L$ are 5.167 and 0.946. The elasticity of substitution (σ) between wages and employment is evaluated for all of the entries above at the overall mean values of real wages and employment, namely, 3.24 and 262 respectively and with $w^a/p = 1.66$, its mean value.

the two sets of estimates. The results presented in Table II correspond
to the use of the wage of retail trade workers for w^a. According to
the estimates in line (i), λ is very close to -1 and β is not
appreciably greater than unity so that the first term in the union's
objective function approximates the expression $\mu \log (\frac{w}{p} - \frac{w^a}{p})$.
However, with μ significantly different from 0.5 and η significantly
different from unity judged by conventional criteria, the data do not
seem to be consistent with an objective function that takes the form of
the rents from unionization. Equation (9) is normalized with respect to
the logarithm of real wages, but the instrumental variables estimator of
a nonlinear equation is not invariant to the variable selected for
normalization. Consequently, the estimates in line (ii) of Table II
report the effects of rewriting equation (9) so that $\log L$ constitutes
the left-hand side variable and where the same set of instruments are
used for $\log (w/p)$. These estimates do not differ appreciably from
those in line (i) except that λ and η are closer to being equal to
one another. However, β remains significantly different from unity so
that a simple constant-elasticity-of-substitution (CES) function does
not appropriately describe this union's objectives.

The estimates reported in line (iii) correspond to fitting equa-
tion (9) after augmenting it with a vector of dummy variables for each
of the union locals. In particular, suppose the slope of the labor
demand function is $s = \exp (\alpha X + \sum_i \delta_i Z_i)/r$ where Z_i takes the value
of unity for the ith union local and of zero otherwise. Then equation
(9) is respecified to include the terms $\sum_i \delta_i Z_i / \lambda$ within the square

brackets. The resulting estimates of the objective function parameters do not differ in any meaningful sense from those in the previous lines. In particular, the estimates are not consistent with the special functional forms that are nested in our specification, namely, the wage bill maximand, the rents from unionization, and the CES function.

Line (iv) of Table II reports the estimates of equation (9) that treat output (in addition to employment) as endogenous.[13] The most noticeable feature of these estimates is the increase in the standard errors over those in previous lines and no doubt this reflects, in part, the inadequacy of our instrumental variables. These estimates testify to the fact that confident inferences from these results about the nature of this union's objectives are simply unwarranted at this stage of the research.[14]

To this point, although differences among the ten cities have been permitted in the slope of the labor demand constraint, the parameters of ITU's objective function have been assumed to be the same for all ten locals. Previous work [Dertouzos and Pencavel, 1981] suggested that the objective function probably varied with the size of the union so this sample of ten ITU locals was split into two categories of five relatively small union locals and five relatively large union locals. The large union locals consist of Cincinnati, Memphis, Louisville, Columbus, and Albany and over the 1946-65 period their average real wages ranged from 3.38 to 3.58, their employment averaged 418, and they operated in the larger cities with an average 1960 population of almost 400,000 people (see Table I). The small union locals are those in

Augusta, Columbia, Dubuque, Fond du Lac, and Elmira and in these years
they had a lower average real wage (namely, 2.96), their average employ-
ment was 78, and they were located in the smaller cities with an average
population in 1960 of 61,000 people. On all three criteria (real wages,
employment, and population), the smallest of the group of relatively
large union locals was greater than the largest of the group of rela-
tively small union locals. Then equation (9) augmented by a vector of
union dummy variables (i.e., by the terms $\sum_i \delta_i Z_i / \lambda$ in the notation
introduced earlier) was fitted to each of the two groups of union
locals. The results are presented in lines (v) and (vi) of Table II,
the relatively large union locals in line (v) and the relatively small
union locals in line (vi).

Although the estimated standard errors caution against confident
inferences, the larger ITU locals tend to place slightly more weight on
"supernumerary" real wages relative to employment (as given by μ).
This may be the consequence of the greater alternative employment possi-
bilities (especially in commercial printing) available in the bigger
cities where the larger unions were located. The smaller union locals
reveal less restricted opportunities of substituting real wages for
employment in their objectives (as given by σ) than the larger union
locals and, indeed, for the smaller union locals the hypothesis of a
unitary substitution elasticity cannot be rejected. For the larger
union locals' estimates in line (v), each of the null hypotheses
$\beta = 1$, $\mu = 0.5$, $\lambda = -1$, and $\eta = -1$ cannot be rejected by conventional
criteria and these are precisely the parameter values implied if the

union locals maximize the rents from unionization.[15/] This does not

appear to be an appropriate description of the objective function,

however, for the group of relatively small union locals (line (vi)). A

conventional test of the null hypothesis that the two groups of union

locals have the same objective function parameters is decisively

rejected.[16/] Further disaggregation to the level of each individual

union local seems not to be warranted, however.[17/]

What appears to be a common finding in all the results in Table II

is an estimate of the elasticity of substitution (σ) between wages and

employment in the ITU's objective function that lies between zero and

unity. Only for the relatively imprecise estimates in line (iv) (in

which both employment and output are endogenous) is σ not signifi-

cantly different from zero. In other words, these results are fully

consistent with Cartter's conjecture that a union's objectives allow

relatively little scope for substituting wages for employment. However,

the limiting case of fixed wage and employment combinations also appears

to be rejected by these estimates.[18/]

V. Conclusions

Two approaches to the issue of wage and employment determination

in unionized labor markets can be identified. One approach takes the

objectives of the trade union as given and enquires into the character-

istics of the solution to the resulting bargaining problem [de Menil,

1971; McDonald and Solow, 1981; Rosen, 1970]. The second approach takes

as a maintained hypothesis the method through which wages and employment

are settled and investigates the objectives of the union [Dertouzos,
1979; Dertouzos and Pencavel, 1981; Farber, 1978]. This paper has
followed this second approach and has shown that, contrary to widespread
belief, the questions involved in ascertaining the objectives of trade
unions can be addressed through conventional empirical procedures. The
union examined here is the ITU over the period 1946-65 and perhaps our
most consistent finding is that the elasticity of substitution between
wages and employment in the union's objective function tends to lie
between zero and unity. This suggests quite restricted opportunities
for trading off wages for employment. The larger ITU locals possess
objectives that approximate the rents from unionization although it
would be imprudent to attach a high degree of confidence to this
inference in view of the standard errors accompanying the point esti-
mates of the objective function parameters. Moreover, it should be
stressed that the empirical implementation of the model requires speci-
fications for two behavioral relationships, the union's objective func-
tion and the firm's labor demand function (or the first derivatives of
both functions), and, therefore, estimates of the union's objective
function parameters may be sensitive to the precise specification of the
labor demand function.[19/]

What do these results suggest for the two empirical anomalies
alluded to earlier, namely, the time series movements of wages in the
printing industry and the variation in typographers' wages across
different cities? Because bargaining takes place at the local level, it
is not surprising that aggregative variables such as the unemployment

rate in the entire economy are not highly correlated with movements over
time of wages in the printing industry. On the other hand, the model of
the wage-setting process outlined in this paper does identify the con-
sumer price index as being relevant to money wage differences as should
be differences in the exogenous variables of the labor demand function
(such as the prices of other inputs and the factors determining news-
paper output). If the objective functions of these union locals are
characterized by little substitutability between wages and employment,
then differences in the slope of the labor demand function will generate
relatively small differences in (real) wages. In this event, the inter-
city variation in wages is a consequence of differences in the location
of the labor demand function with, for instance, newspapers in big
metropolitan areas with a larger circulation paying higher wages (which
is exactly what is observed). On the other hand, if more observations
on each union local were available, then the objective function para-
meter estimates in Table II might be more precisely estimated and sig-
nificant differences across union locals might emerge. If this were the
case, the observed intercity variation in wages would reflect, in part,
the different weights attached to wages in the unions' objective func-
tions and, then, an explanation for these variations in objectives would
be called for.

A very large body of research now exists that applies constrained
optimization models of the household and of the firm to data on consump-
tion expenditure and production. In contrast, the literature on the
behavior of the union became enmeshed in unproductive methodological

squabbles and economists turned their interest towards the measurement of the various effects of unions without imbedding their measurement procedures in precisely articulated behavioral models. Consequently, there is a large body of research documenting the empirical regularities associated with unionism, but there is little interpretation of these regularities in terms of economic behavior. The primary purpose of this paper has been to show by way of example that purposive models of unionism (such as the one outlined here) have operational content and can be analyzed empirically.

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Footnotes

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1/   For instance, in Wachter's [1970] time series analysis of wages in two-digit manufacturing industries, his preferred equation for the printing industry has only a time trend as a relevant regressor and no significant role is found for the unemployment rate, for price changes, and for movements in the industry's value added. Even more striking are the results reported by Eckstein and Wilson [1962] where R^2's for wage changes in the printing industry are recorded of 0.01 while most other industries generate R^2's greater than 0.90.

2/   The Bureau of Labor Statistics' wage surveys reveal that for hand compositors at night work in the newspaper industry workers in the city reporting the highest wage earned 55% more in July 1946 and 28% more in July 1965 than workers in the city reporting the lowest wage. This range is all the more remarkable in view of the fact that these wage data relate to workers in a narrowly-defined occupation, the members of which possess very similar characteristics from city to city. (These data are published in BLS Bulletins No. 912 and No. 1489.)

3/   Indeed, even with further restrictions on the model, ambiguities prevail. For instance, suppose the slope of the labor demand function is independent both of wages and of the scale of production (i.e., suppose $\partial s/\partial w = \partial s/\partial X = 0$). Then the effect on optimal wage of a proportional increase in output is

$\partial \ell nw/\partial \ell nX = \sigma \, e_x L(g_1^{-1} g_{12} - g_2^{-1} g_{22})/(1 + swL^{-1})$ where e_x is the elasticity of the demand for labor with respect to output, $g_{12} = \partial^2 U/\partial w \partial L$, and $g_{22} = \partial^2 U/\partial L^2$. If, in addition, the union's preferences are homogenous with respect to w and L, then $\partial \ell nw/\partial \ell nX = \sigma e_x L g_1^{-1} g_{12}$. These expressions are ambiguous in sign.

4/   The adversaries in this debate were, of course, Dunlop [1944] who
     maintained, "An economic theory of a trade union requires that the
     organization be assumed to maximize (or minimize) something.
     Although not the only possible objective, maximization of the wage
     bill may be regarded as the standard case" (p. 4) and Ross [1948]
     who responded, "The wage policy of unions...is not to be found in
     the mechanical application of any maximization principle" (p. 8).

5/   Cartter [1959, pp. 89-90] wrote: "It would seem most likely, once
     a union is already enjoying a particular wage-employment
     combination, that it would take a considerable increase in wages
     to compensate for a reduction in employment, and it would take a
     considerable increase in employment to compensate for a wage
     reduction. This is reasoned to be true because of the internal
     political pressures the union would be subject to if it openly
     agreed to either of these reductions."

6/   The justifications for these statements are to be found in the
     classic study by Lipset, Trow, and Coleman [1956].

7/   See Kelber and Schlesinger [1967]. Today the very survival of the
     ITU in its traditional form is threatened by the diffusion of
     typesetting computers and photographic processes which have
     eliminated many of the skills once required of printers. The
     dramatic consequences of this automation for New York's Local 6
     are documented by Rogers and Friedman [1980].

8/   These data were obtained by James Dertouzos while consulting for
     the proprietors of the Cincinnati Post.

9/   Dertouzos [1979] and Dertouzos and Pencavel [1981] fitted the
     reduced form real wage equation jointly with the stochastic form
     of the employer's labor demand function. The estimates so derived
     were very similar to the maximum likelihood estimation of the
     reduced form real wage and employment equations as given in
     Pencavel [1982].

10/ Output is measured here by the amount of advertising linage sold
     annually and average values of this variable are listed in Table
     I. This output index measures only one dimension (albeit the most
     important in terms of newspaper revenues) of newpaper output and
     is not perfectly correlated with other dimensions such as the
     space devoted to news. Moreover, although many of the primary
     determinants of output are beyond the control of the newpaper firm

(in particular, the size and wealth of a city's population and the number of television channels to which advertisers have access), it would be inappropriate to treat output invariably as exogenous. For these reasons, a set of estimates was derived for which output was characterized as endogenous. These are reported below.

11/ Thus, the labor demand function implied by this expression for s is $L = f(\cdot) - (w/r) \exp(\alpha X)$ where $f(\cdot)$ is some unspecified function of X, r, and the prices of other inputs (except for w).

12/ The exogenous variables consist of $\log(p/r)$, X, w^a/p, the wholesale price index of machinery and equipment and quadratic terms and interactions among these variables.

13/ The exogenous variables used to instrument for employment and output in this equation are $\log(p/r)$, w^a/p, $\log q$, $(w^a/p)^2$, $(\log(p/r))^2$, $(\log q)^2$, T, $T \cdot \log q$, $T \cdot \log(p/r)$, and $T \cdot w^a/p$ where q is a wholesale price index of machinery and equipment and T is a time trend.

14/ For all these estimates, the quasi-concavity condition (equation (8)) was satisfied for all observations in the sample.

15/ The elasticity of substitution (σ) is a highly nonlinear function of all the objective function parameters, however, so that, although each of the objective function parameters is not significantly different from the value assumed under the rent maximization hypothesis, σ is significantly different from unity (which is the value taken by σ is the union's objectives were exactly rent maximization).

16/ In this case, the calculated value of the F statistic is 9.94 which exceeds by a large margin the critical value from the F distribution.

17/ For the group of large union locals, the null hypothesis of no difference in the objective functions among the five locals yields a calculated F of 1.52 while the corresponding value for the group of small union locals is 2.01. Each of these falls short of the

critical F value at the 1% percent level of significance. Of course, these test statistics are only approximate in this instrumental variable context.

18/ In equations fitted to each union local separately, a number of variations in the estimation procedure were applied to equation (9). First, the constraint that the slope of labor demand function be homogenous of degree minus unity in input prices was relaxed. Second, the equation was fitted in first difference form (year to year changes) with allowance for a linear time trend. Third, the objective function parameters were allowed to change after a merger between newspapers in those four cities in which a merger was recorded in these years. In each of these cases, the inferences about the objective function of the ITU were not materially different from those in the main text.

19/ Some examination of this issue was undertaken by specifying different slopes for the labor demand function. The resulting estimates of the union's objective function parameters were not substantially different from those reported above.

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