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WAGES AND EMPLOYMENT UNDER TRADE UNIONISM:
MICROECONOMIC MODELS AND MACROECONOMIC APPLICATIONS

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Abstract

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The first part of this paper critically surveys microeconomic research into behavioral models of trade unionism. Though certain formulations of union objectives and models of wage and employment determination in unionized markets have found favor with economists, unfortunately only a little is known about their empirical relevance. The second part of this paper considers the daunting problems of applying these models at the macroeconomic level. One such model is estimated with data from Sweden's manufacturing and mining sector from 1968 to 1982.

Wages and Employment Under Trade Unionism:
Microeconomic Models and Macroeconomic Applications

John Pencavel*

I. Introduction

The purpose of this paper is to provide a perspective on recent microeconomic research concerning behavioral models of trade unionism and to consider some macroeconomic applications of these models. There are at least two reasons why an understanding of the way in which trade unions behave is an important issue in economics research. First, there now exists a substantial volume of evidence that, at least in the United States, Canada, and Britain, trade unions affect the terms of employment for workers covered by collective bargaining agreements. The magnitude of these effects varies considerably in a number of different dimensions, but a comprehensive explanation for these variations is really lacking. Models of trade union behavior are needed, therefore, to help account for these empirical findings.

Second, models of unionism may contribute towards an understanding of how nonunionized labor markets operate. Over the past 25 years there has been a remarkable change, at least in academic research in the United States, in the approach that economists have taken towards modelling the operation of labor markets. At one time, an influential opinion held that, though no doubt there were differences between unionized and nonunionized labor markets in some respects, these tended to be of second-order of importance and the most profitable research strategy was to characterize unionized markets as if they imitated nonunionized markets in which labor services were exchanged for money in a series of ongoing spot transactions. The current fashion adopts a

posture that is virtually the direct opposite of this: in part because of the belief that almost all jobs involve some element of specific human capital and thus a bargaining situation is intrinsic in employer-employee relationships, nowadays nonunionized labor markets are characterized as if workers are involved in a long-term association with their employers and the class of models drawn upon are those of bilateral monopoly that have been the staple of students of trade unionism. Often unwittingly, therefore, recent debates over the appropriate way to model the bargaining relationship in labor markets (nonunion as well as union) touch on similar issues to those covered over 30 years ago by Dunlop (1944), Leontief (1946), Fellner (1947), and Ross (1948) in their analyses of trade unionism. Consequently, a better understanding of how trade unions behave may pay dividends in terms of more satisfactory models of nonunion labor markets.

In this paper I restrict myself to examining those activities of a trade union that bear on the determination of wages and employment in a firm or group of firms. Because these represent a subset of the union's functions (and, indeed, there is evidence to suggest that unionized workers place greater value on other services provided by the union), the perspective on trade unionism below is necessarily incomplete. The models of wage and employment determination in Sections II and III are distinguished by three features: first, there is the specification of the objectives of the parties; second, there is the delineation of the constraints under which they operate; and, third, there is the description of the properties that the ultimate contract must have. In outlining these features, I shall often refer to the two parties as "the employer" and "the union," but some important issues lie behind these innocuous labels. Nowadays the people who occupy the role of

employer in bargaining situations are rarely the firm's proprietors, but are usually other employees. There is, of course, a large literature on the appropriate objective function of the firm when ownership and management are separated, but to focus on other matters I am going to neglect that literature here and proceed on the assumption that one party to the bargaining situation, the employer, maximizes profits. This assumption is almost certainly inappropriate in certain contexts (especially, though not exclusively, in nationalized industries) although it should be noted that some of the results below will hold when profits represent one argument of a more general objective function.

The research on the separation between ownership and control in the theory of the firm has a direct parallel in the literature on the objectives of the trade union. Arthur Ross' (1948) classic study can now be seen as a vigorous statement (by someone extremely well-informed of the institutions) of the problem of defining the trade union's objective function in the presence of divergent interests among rank-and-file union members and in the presence of divergent interests between union officials and the rank-and-file. Not merely are there the classic social choice problems of defining a well-behaved objective function for a group of diverse individuals, but also the union's objectives may be more difficult to determine because of a concern for the welfare of workers not represented by the union. When union leaders and union workers claim to further the interests of other workers, their statements are typically dismissed by economists as self-serving or misguided attempts to disguise or merchandise their selfish motives. Altruism may well not be a relevant factor in a number of cases, but at the same time in parts of North American and West European societies there are deep traditions of working

class fellowship and in such instances it would be short-sighted to presume that such sentiments have no behavioral consequences. In the face of these serious problems of specifying the objectives of the trade union, the work economists have actually accomplished is really quite modest, as shown in Section II.

Questions of wage and employment determination in a unionized market are taken up in Section III while Section IV considers whether these microeconomic models of trade unionism can be used to develop structural relationships concerning the movement of wages and employment at the macroeconomic level. I argue that there are formidable problems in using the models outlined in Sections II and III for macroeconomic purposes in those economies where collective bargaining is decentralized or where there exists an important sector not covered by collective bargaining agreements. The difficulties in applying these models at the macroeconomic level are less formidable for economies where collective bargaining is highly centralized and where virtually all wages are affected by a national agreement between a confederation of trade unions and a confederation of employers. As a first pass at how one might proceed in such an institutional setting, I present the consequences of naively applying a model of trade union behavior to aggregate wage and employment data for Sweden.

II. The Trade Union's Objectives

The most popular approach in the last few years towards modelling trade union objectives has ignored the tough social choice and principal-agent problems mentioned in the Introduction and has identified these objectives with those of a single union member. Typically, this approach assumes that

all union members are identical, employment at the union-negotiated real wage, w , is uncertain, and all union members stand the same chance of being employed at that wage. Then the expected utility of a union member is a weighted average of the utility of real income when employed on this union's contract and the utility of real income when employed at the best alternative to this contract:

$$(1) \quad r(w, L, M) = U(w) \frac{L}{M} + U(\bar{w}) \left(1 - \frac{L}{M}\right)$$

where $w > \bar{w}$ and $0 < L \leq M$. The individual worker's well-behaved utility function is $U(\cdot)$ and the trade union's objective function is $r(\cdot)$. In this equation $\bar{w}$ is the real income from the best alternative employment (perhaps unemployment benefit) and this is assumed to be exogenous. L represents the total number employed on this contract and M is total union membership. Each and every worker is presumed to have the information to calculate the employment probability, L/M . This association of the union's objectives with the typical union member's and the characterization of the union member's objectives in terms of expected utility were standard fare in graduate instruction at several universities in the 1970's. The first empirical application of equation (1) came with Farber's (1978a, 1978b) study of the United Mine Workers.^{1/}

In the literature that uses equation (1) as the union's objective function, union membership, M , is invariably treated as exogenous. Usually, little explanation is offered for this assumption. In fact, the correct treatment of union membership will depend on the characteristics of the particular union under study. In many industrial unions, union membership accompanies employment with a particular employer or group of employers and

the termination of this employment also terminates union membership. Here union membership is more an attribute of the job than of the individual. In this case, an argument can be made for M in equation (1) in any period being represented by the number of the firm's employees in the immediately preceding period. In many craft unions, an individual's union membership lasts longer than the duration of a contract with a particular employer. Indeed, starting with his apprenticeship and ending with his pension, the individual may well carry his union membership with him throughout his working life. In this case, by controlling the number of apprenticeships and by affecting the geographical distribution of employment through rules guaranteeing work for union members who move to different cities,^{2/} membership is carefully regulated by the union and a high value is placed on securing employment for the entire membership. Indeed, through worksharing and perhaps the negotiation of make-work rules, all members are employed. For both the industrial and the craft union, therefore, the size of its membership at any time is set with respect to some intertemporal objectives. These objectives have not been the subject of any satisfactory analysis to date. In what follows, in order to focus on other issues, I shall follow this literature in assuming M to be an exogenous variable (and therefore the union's welfare is a decreasing function of its membership) even though this is unquestionably inappropriate for a large number of unions.

Assuming then that union membership is exogenous, and provided the worker can estimate the correct employment probability (L/M), the expected utility maximand may have some appeal when characterized at the level of an individual worker for whom income in the less preferred state, $\bar{w}$, is exogenous. But it is by no means obvious that it is an appropriate

characterization for a group of individuals, such as a trade union, that can engage in income redistribution and that can affect the income received by its members if they are not employed on the union's contract. Expressed differently, the expected utility formulation in equation (1) results in identical (by assumption) members receiving different ex post outcomes and it is not clear why a union composed of homogeneous individuals should remain passive in these circumstances when it has the power to affect the level of income enjoyed in the two states. Thus suppose each union worker pools his income, the employed contributing a total of wL to the pool and the unemployed contributing $\bar{w}(M - L)$ to the pool where $\bar{w}$ is their unemployment benefit. The union then redistributes this total income, $wL + \bar{w}(M - L)$, such that each unemployed member receives $\tilde{w}_u$ and each employed member receives $\tilde{w}_e$. How far should the union go in redistributing income? If the union undertakes this redistribution in such a way as to maximize the weighted averaged of the utilities of the employed and the unemployed (that is, $u(\tilde{w}_e)(L/M) + u(\tilde{w}_u)(M - L)/M$), then this requires the marginal utility of income for each employed union member to equal the marginal utility of income for each unemployed union member (that is, $u'(\tilde{w}_u) = u'(\tilde{w}_e)$). This means post-redistribution incomes must be the same ($\tilde{w}_u = \tilde{w}_e$) because we have been assuming all union members have identical, state-independent, preferences. In view of the fact that redistribution takes the form of equalizing incomes, the union does the best for its members by maximizing their contributions (from whatever source) to the pool, namely, $wL + \bar{w}(M - L)$. Or, because we are following the literature in assuming membership to be fixed and exogenous, this is equivalent to an objective function that is given by the rents from unionization:

$$(2) \quad r(w, L) = (w - \bar{w})L \quad .$$

This monetary objective is sometimes interpreted as the union's counterpart to the maximization of profits by the firm. Therefore, when the union redistributes income in this way, the logical implication of the assumptions behind equation (1) is an objective function for the trade union that takes the form of rents from unionization.

The union's redistribution policy in the previous paragraph leaves the incomes of each employed and each unemployed member the same. Because the unemployed member avoids the disutility of work and yet has the same command over consumer goods as the employed member, the union must be in a powerful position to enforce this sort of redistribution and it may be hard pressed to devise measures that avoid the moral hazard problems arising from employed members engineering to join the ranks of the unemployed. It may be more plausible to assume that, if redistribution takes place within the union, incomes are not equalized, but the utilities of each employed and each unemployed member are equalized where the employed member receives a higher income to offset the disutility of work.^{3/} That is, the union redistributes income such that $u(\tilde{w}_e) = u(\tilde{w}_u) + k$ where k is the utility of not having to work for an income. If the union again concerns itself with the weighted average of the utilities of the employed and the unemployed members, then the objective is now to maximize $u(\tilde{w}_e)$ (which equals $u(\tilde{w}_u) + k$). This is not equivalent to maximizing the rents from unionization, equation (2), because the union is not valuing a marginal dollar received by an employed member at the same rate as a marginal dollar paid to an unemployed member. In this instance the union maximizes $u(\tilde{w}_e)$ where $\tilde{w}_e$ is defined by the union's

redistribution constraint $wL + \bar{w}(M - L) = \tilde{w}_e L + \tilde{w}_u (M - L)$ and where $\tilde{w}_e$ and $\tilde{w}_u$ must satisfy the requirement $u(\tilde{w}_e) = u(\tilde{w}_u) + k$.

Is the income redistribution within the union discussed in the previous paragraphs at all relevant to modern trade unionism? There is no question that some explicit redistribution goes on when a sizable and drastic reduction in the work force is called for, a reduction induced perhaps by a technological development that alters the production function or by a sudden change in product market conditions. In these instances a permanent reduction in employment and union membership is being accommodated. Over the business cycle, there is less of such explicit income redistribution, but it goes on in a few unions.^{4/}

Although most unions may not make explicit payments to their unemployed members, some observers might argue that they engage in implicit income redistribution through the state unemployment insurance system. That is, the level of state unemployment benefits received by an unemployed worker is endogenous to a union's behavior insofar as these benefits are linked to the individual's recent wage income (which is obviously under the union's control) and insofar as payroll taxes for the financing of unemployment compensation are related to the number of the firm's workers who are drawing these benefits (i.e., to the number made unemployed which is also affected by the union's actions). In an unemployment system such as that in the U.S., there may be something to this argument even though the linkages are weak.^{5/} It certainly seems contrived to characterize unemployment benefits in this way in countries where the financing of unemployment compensation involves an even more loose relationship between the firm's taxes and the unemployment benefits received by its former employees.

Another form of intra-union income redistribution, it may be argued, consists of seniority provisions in layoff procedures where those with relatively little tenure transfer income to those with greater tenure. In this case, seniority provisions simply reallocate one's income over one's working life and the union's objective function must be defined in terms of each worker's lifetime utility. However, once we introduce a characteristic such as seniority, we are no longer assuming all members to be identical, problems arise in aggregating the preferences of members whose years of tenure differ, and with membership and employment changing over time the long-run objectives of the union become very difficult to define.

Redistribution within the union need not take place only through explicit payments from the employed to the unemployed union members, but also by worksharing so that all members participate in fewer working hours and in lower weekly incomes. In the unionized sector of the United States about 36 percent of workers in the early 1970's were covered by contracts that provided for some sort of worksharing. They were prevalent in the apparel industry (where they have existed for many years) and in the rubber, steel, and leather industries.^{6/} However, these worksharing clauses of U.S. collective bargaining contracts appear to be invoked infrequently.^{7/} One reason for this is that in most U.S. states the unemployment insurance system does not allow benefits to be paid to someone working only 4 out of 5 days per week and in this sense the system tilts incentives in favor of layoffs and against worksharing.^{8/}

The conclusion from this discussion of the redistribution activities of trade unions is that clearly some redistribution goes on. However, it is by no means evident that it is implemented to such an extent that members in the less preferred state are fully compensated (in income or in utility) for their

unfortunate draw in the employment lottery. In any event, whenever such redistribution occurs within a union, it is insufficient to describe the union's objectives simply in terms of an expected utility formulation such as equation (1) in which incomes in the less preferred state are taken to be exogenous to the union. The plausibility of the expected utility formulation is, of course, not rendered less suspect once we recognize that in any given context union members are heterogeneous in a number of different dimensions. In fact, I conjecture that the incompleteness of union redistribution schemes arises more often not from the infeasibility of such schemes or from problems in administering them, but from the fact that the union's social welfare function does not treat all union members equally. Indeed, no observer of industrial relations can fail to be impressed with the emphasis placed by most unions on operating rules that govern their members' eligibility and that establish different priorities for various benefits. While an imaginative social choice theorist might conjure up ingenious reasons for these rules being consistent with a union possessing a totally egalitarian objective function, the least contrived explanation is surely that the union does not treat all members the same.

In his research on the United Mine Workers, Farber (1978a, 1978b) explicitly assumed heterogeneity among union members' preferences and yet maintained a maximand such as equation (1) on the argument that a democratic electoral process will induce someone seeking the leadership to advocate the median voter's interests. In this case, equation (1) is no longer to be understood as the expected utility of each identical union member, but as the expected utility of the median voter. Sometimes the median voter is presumed to be the median union member. Again it is assumed the median voter has the

information to calculate the correct employment probability. The case for proceeding in this way is most convincing when each member's utility function contains one argument (say, the wage rate) and when the preferences of the union members are single-peaked. Even if the single-peakedness property is satisfied and even if each individual's preferences are well-behaved, whenever each member's utility function contains more than one argument, majority voting may not generate (in fact, probably will not generate) the sort of transitive relations for the union's preferences that we typically require of each individual's preferences.^{9/} These social choice problems are further aggravated if the electoral process within the union is not adequate for the rank-and-file to monitor their leadership perfectly.

The purpose of the argument above is not to assert that the trade union's objective function cannot be expressed in terms of an equation such as equation (1), but merely to maintain that there are good reasons to doubt whether it is at all appropriate and that it should be regarded as a research hypothesis whose empirical relevance should be tested against observed behavior. This is, after all, the way in which the expected utility hypothesis has been treated in research on individual decision-making under risk where it has been found from numerous tests that, in the words of one specialist, "...at the individual level expected utility maximization is more the exception than the rule....it is doubtful that the expected utility theory should or could serve as a general model" (Schoemaker (1982), p. 552).^{10/} It has been the predictive failures of the hypothesis that have contributed to the development of non-expected utility models of behavior such as prospect theory and regret theory which involve more elaborate expressions both for the probabilities of the events and for the value functions.

This evidence pertains to an individual's decision-making, not to a trade union's decision-making. In fact, not one of the empirical applications of the expected utility hypothesis to the study of unionism has chosen to test whether equation (1) conforms to observed behavior; as yet, equation (1) is simply an untested hypothesis as applied to the objectives of trade unions and moreover a hypothesis that has been found seriously defective in the literature on individual decision-making.

While the expected utility hypothesis has not been the subject of any test in the literature on trade union behavior, by contrast the special case in which the objectives of the union are given by the rents from unionization, equation (2), has been tested on a number of occasions. In different ways the empirical work of Ashenfelter and Brown (1983), Carruth and Oswald (1983), Dertouzos and Pencavel (1981), Farber (1978a, 1978b), MaCurdy and Pencavel (1983), and Pencavel (1984a, 1984b) may all be interpreted as tests of the rent maximization hypothesis as applied to unions representing coal miners and typographers.^{11/} Unanimously, these studies reject the parameter restrictions corresponding to a rent maximand. Naturally these tests proceed under a battery of auxiliary assumptions and it may be that it is these auxiliary assumptions which are at fault and which account for the apparent refutation of the rent maximization hypothesis. This is, indeed, a possibility, but at this stage of research on behavioral models of trade unionism the presumption is surely that the unions studied do not maximize rents.

Other special cases of trade union objective functions--for instance, that employment does not figure in the union's objectives at all--have also been rejected in empirical tests so that it appears as if wages and employment do not enter into a union's objectives in a simple way. Under these

circumstances where union objectives do not correspond to a simple function and where different forms of this function have been estimated, it is not straightforward to summarize the implications of these objective functions. One piece of relevant information, however, relates to the ease with which wages may be substituted for employment in union objectives and a unit-free measure of this is provided by the elasticity of substitution. Consequently, I have calculated from a number of different empirical studies the implied value of the elasticity of substitution between wages and employment evaluated at the mean values of the variables used in each study. These are presented in Table 1 in the column headed $\hat{\sigma}$. The column labelled "mean employment" signals the fact that the estimates of σ in Table 1 relate to very different types of unions: the British miners in Carruth and Oswald's study form a national union that in the period studied by the authors bargained with the managers of a nationalized industry; the U.S. coal miners in Farber's study also constitute a large union that bargains with representatives from many firms to set wages for a substantial fraction (but by no means all) of the workers who mine underground coal; by contrast, the U.S. typographical unions bargain at the local level with city newspapers (typically just one newspaper) and the number of workers covered by each bargain is relatively small. The estimates of the elasticity of substitution between wages and employment thus describe markedly different unions in different bargaining settings. However, all of the workers represented in Table 1 share the characteristic that they have been experiencing a declining demand for their services over the last decade or so.^{12/}

The estimates of σ range from 0.18 to 2.10. Moreover, although standard errors are not provided in Table 1, it should be noted that at least

for typographers^{13/} the values of σ are not estimated at all precisely and usually a wide range of values are consistent with the results. For instance,

Table 1

for typographers, hypotheses that σ equals zero or unity often cannot be rejected by conventional criteria. I interpret these results as follows: beyond the fact that some very simple forms of trade union objective functions appear to be inconsistent with the evidence, not much more is known about the precise form of this function.

III. Wage and Employment Determination

The force of the argument in the preceding section is that, while there are good reasons for supposing that the union's objective function is defined over real wages and employment, we know little about the exact form of the function. The role of union membership in this function is by no means clear. Because increases in union membership reduce the average worker's probability of employment and because there is no role for altruism in this model, the expected utility hypothesis implies that the union's welfare is decreasing in membership. On the other hand, when there is scope for the union leader to pursue his own interests, a larger membership may be welcomed as increasing the leader's constituency and as furthering his larger aspirations in the trade union movement. According to this argument, the union's welfare (identified with the union leader's welfare) is increasing in membership. This is consonant with the fact that unions engage in organizing drives to expand their membership. In any event, for the purposes of the

Table 1

Estimates of the Elasticity of Substitution between Wages and Employment
in a Trade Union's Objective Function

Research	Union	Mean Employment	Form of Objective Function	$\hat{\sigma}$
Carruth and Oswald (1983)	British coal miners	430,240	Expected utility hypothesis with $U(w)$ a power function	0.77
Farber (1978a, 1978b)	U.S. coal miners	232,545	Expected utility hypothesis with $U(w)$ a power function	1.34
MaCurdy and Pencavel (1983)	13 locals of typographers	37	Stone-Geary	2.10
MaCurdy and Pencavel (1983)	13 locals of typographers	37	Quadratic	1.96
Pencavel (1984b)	5 small locals of typographers	78	Augmented addilog	0.71
Pencavel (1984b)	5 large locals of typographers	418	Augmented addilog	0.19
Pencavel (1984a)	Cincinnati's typographers	172	Stone-Geary	0.76
Pencavel (1984a)	Columbia's typographers	105	Stone-Geary	0.27
Pencavel (1984a)	Dubuque's typographers	68	Stone-Geary	0.43
Pencavel (1984a)	Memphis' typographers	323	Stone-Geary	0.26
Pencavel (1984a)	Pond du Lac's typographers	41	Stone-Geary	0.18
Pencavel (1984a)	Columbus' typographers	602	Stone-Geary	0.22

NOTE3: The values of $\hat{\sigma}$ for MaCurdy and Pencavel (1983) are derived from estimates specifying the production technology to be Cobb-Douglas. For a constrained translog production function, the estimates are 1.69 for a Stone-Geary objective function and 2.12 for a quadratic objective function for the union. These estimates for MaCurdy and Pencavel (1983) represent the average of the $\hat{\sigma}$'s calculated for each observation in the sample.

analysis in this section, we specify the objectives of the trade union as

$$(3) \quad \Gamma = g(w, L, M)$$

where Γ is increasing in w and L and is ambiguous in sign with respect to increases in M .

The firm's objective is assumed to be the maximization of net revenue although for much of the subsequent analysis it is sufficient that net revenue be one argument in a more general maximand for the firm. If R denotes the firm's gross revenue, K_i the level of input i employed by the firm, and r_i the unit price of each input i , then the firm's net revenue Π is as follows:

$$(4) \quad \Pi = R(L, K_1, \dots, K_n) - wL - \sum_i r_i K_i .$$

The problem now is to determine the form of the contract between the union and the firm.

In a bilateral monopoly setting such as this, there is a strong tendency for economists to assume that each of the parties will not leave unexploited opportunities to improve its welfare and that efficient contracts will be negotiated which lie on the contract curve (or, equivalently, on the payoff frontier). Under these circumstances, the wage-employment combination must satisfy the following first-order condition:

$$(5) \quad \frac{\partial g / \partial L}{\partial g / \partial w} = L^{-1} \left(w - \frac{\partial R}{\partial L} \right) .$$

Because both $\partial g / \partial L > 0$ and $\partial g / \partial w > 0$, it is evident that the wage exceeds the marginal revenue product of labor, i.e., the profit-maximizing firm is using more labor at a wage of w than it would do in a situation in which the

union's welfare did not depend upon employment. This first-order condition describes many different combinations of w and L , of course, each combination corresponding to a different point on the contract curve. Some particular solution concept is required to determine which single combination of these many efficient wage and employment exchanges will obtain. Also note that, if X denotes the firm's output, when the first-order condition for the optimal use of input j is divided into equation (5), the following equation is derived:

$$(6) \quad r_j y_j = w - Lm$$

where $y_j = (\partial X / \partial L) / (\partial X / \partial K_j)$, the ratio of the marginal product of labor to the marginal product of input j , and $m = (\partial g / \partial L) / (\partial g / \partial w)$ is the marginal rate of substitution of employment for wages in the union's objective function. Because $r_j / (\partial X / \partial K_j)$ is equal to the firm's marginal revenue, the left-hand side of equation (6) is simply the firm's marginal revenue product of labor which, in this efficient contract setting, falls short of the wage rate.

Following Leontief (1946), Fellner (1947), and McDonald and Solow (1981), a graphical analysis may well be instructive. In Figure 1, the union's indifference curves between w and L are given by $\Gamma_0, \Gamma_1, \Gamma_2$, etc., the indifference curves subscripted with higher numbers corresponding to higher utility. The firm's isoprofit curves between w and L are given by Π_0, Π_1, Π_2 , etc., where again those subscripted with higher numbers correspond to higher profits. Given the shapes of the indifference curves in Figure 1, the contract curve, CC' , slopes upwards to the right. The contract curve need not have this shape: if management

maximizes profits and the form of the union's objective function is given by rents, equation (2), then the contract curve will be vertical; if the union's objective function is given by the expected utility hypothesis, equation (1), where $\bar{w}$ is exogenous, then the contract curve will be upward sloping as drawn in Figure 1; if the union redistributes income between the employed and unemployed such that the utilities of each employed and unemployed member are equalized (taking account of some disutility of work), the contract curve will be negatively-sloped. Equations (5) and (6) above describing the contract curve equilibrium hold whether the contract curve is forward-sloping, vertical, or backward-sloping.

Figure 1

Although efficiency in contracting has a powerful hold on economists, it has not been established that union-management collective bargaining contracts satisfy the conditions for efficiency. After all, the collective bargaining process is one in which each party tries to camouflage its true valuations from the other party and reaching the contract curve requires each party to detect the guile in the other party's behavior. Perhaps they do, but it is not obvious that they do. Moreover, even if an efficient contract is struck, each party has to monitor the performance of the other to ensure that the terms of the contract are being fulfilled. Disputes during the administration of a contract are by no means uncommon and some of them may well be the consequence of attempts by one or other party to improve its welfare and perhaps to move off the contract curve.

Typically the collective bargaining contract specifies much more clearly

Figure 1: Wage and Employment Determination

and precisely the wage rate and the fringe benefits to be paid than employment and, therefore, a relatively large proportion of the grievances during the contract involve issues of employment. It is as if, once the contract has been negotiated, each party takes the wage rate and fringe benefits as given and each tries to engineer an increase in its welfare by changing employment--reducing it in the case of the employer and increasing it in the case of the union. The fact that the entire contract is to be renegotiated sometime in the future tempers the extent to which each party engages in opportunistic behavior during the current contract; in other words, the parties are involved in a repeated game and, if one party is seen as not living up to the terms of its agreement now, the other party may well be more intransigent the next time the contract is negotiated. Nevertheless, management in particular not only has the incentive, but also the opportunity to reduce employment at the negotiated wage (perhaps by not replacing workers who quit or retire) and to increase profits until the marginal revenue product of labor is raised to the level of wages:

$$(7) \quad r_j y_j = w \quad ,$$

where again $y_j = (\partial X / \partial L) / (\partial X / \partial K_j)$. In terms of Figure 1, at a wage of w_1 employment on the contract curve is given by L_1 whereas employment on the firm's labor demand function, DD' , is L_2 . At the coordinates $w_1 L_2$, equation (7) holds. This particular outcome at which the firm is on its wage-taking labor demand curve may be understood in one of two ways: first, as the solution to a standard principal-agent problem where the principal (the union) cannot prevent the agent (management) from determining employment according to its (the agent's) own interests; or, second, as a Stackelberg solution to a

noncooperative game where the union acts as the leader in setting the wage to maximize its objective function, equation (3), and management follows this union-determined wage by adjusting employment according to its optimizing labor demand function.^{14/}

The preceding characterization of wage and employment determination in unionized markets--the union sets the wage rate to maximize its objective function, equation (3), subject to the constraint given by the employer's labor demand function--has been called "the monopoly model" (McDonald and Solow (1981) or Oswald (1983)) or "the labor demand curve equilibrium model (LDEM)" (MacCurdy and Pencavel (1983)). It has appealed to economists aware of the fact that collective bargaining contracts in North America and West Europe often grant the employer considerable discretion over matters concerning employment. Because the labor demand function constrains the fulfillment of the trade union's objectives of higher wages and higher employment, the model is suited to Marshall's (1920) well-known analysis (later elaborated by Hicks (1932) and taken up by Friedman (1951)) whereby the slope of the derived demand curve for labor regulates the magnitude of the union-nonunion wage differential. The same model lies behind Gregg Lewis' (1963) often-cited calculations of the effects of unionism on wages and employment in the United States from 1920 to 1958.

The question that naturally arises is "Are wages and employment determined according to this monopoly model or are the two parties on their contract curve?" The manner in which the two models have been specified above suggests how this question might be addressed. Because if the monopoly model is an apt representation of the labor market, then equation (7) is the appropriate first-order condition describing optimal employment whereas, if

contracts are efficient, then equation (6) holds. (Of course, neither model may be relevant.) Observe that equation (7) relating to the monopoly union model is, in fact, a special case of equation (6) that describes efficient contracts, namely, the special case which omits the term $-Lm$ from the right-hand side. A test of whether, after controlling for wages, the term $-Lm$ enters to help determine $r_j y_j$ is a test of whether employment is set according to the union monopoly model. A convenient feature of this test is that it is consistent with the contract curve being negatively-sloped or positively-sloped or vertical in wage-employment space.

This is essentially the procedure applied by McCurdy and Pencavel (1983) who pooled data relating to the International Typographical Union over time (1945-73) and over thirteen different towns in the United States first to estimate the production function for the newspaper composing room and, with y_j thus constructed, to estimate a stochastic version of equation (6) using a number of different expressions for m . We found that the parameter restrictions that would permit us to omit the term $-Lm$ from equation (6) were decisively rejected at conventional levels of significance for every specification considered. This result is evidence against the Marshall-Friedman-Lewis characterization of employment determination in unionized labor markets at least insofar as the I.T.U. is concerned; this result does not, of course, establish the veracity of the efficient contracts model. Nevertheless, when estimating equation (6), the implied parameter values of m were broadly consistent with the union's objectives taking the form of a quasi-concave function of real wages and employment. This is support, though weak support, for the proposition that in these towns and over these years the local agreements between the I.T.U. and the newspaper proprietors were on the

contract curve.

Naturally one labor market study does not establish the presumption that union-employer collective bargaining agreements usually fall on the contract curve. Indeed it would be truly remarkable if the same model of behavior characterized all labor markets. What is needed is a large number of empirical studies, each of which examines a particular labor market. Only through the painstaking compilation of these studies can the relevance of these and other models of wage and employment determination be assessed.

IV. Macroeconomic Applications

Institutional Structure

The models outlined in the preceding sections have been concerned with the determination of wages and employment in a single labor market. How must these models be amended so that they can be used to describe wages and employment at the aggregative level and so that the econometric fitting of macroeconomic wage and employment equations estimate structural parameters of interest? Of course, the aim of this work could be the more modest one of simply outlining the central features of the macro-economy without attempting to subject these stylized models to econometric estimation. This is certainly how some economists view the role of macroeconomics, but if all statistical estimation is eschewed it becomes especially difficult to discriminate between rival models that purport to describe the same empirical regularities. Without some attempt to test competing conjectures about the operation of markets, there is no end to the ability of imaginative economists to concoct ingenious models that can claim some casual correspondence to reality. I take it as given, therefore, that we are seeking models containing testable

propositions about relationships among various macroeconomic variables and typically the investigation of these testable propositions requires some recourse to econometric estimation.

A macroeconomic model of an economy's labor markets is unlikely to be appropriate unless it is consonant with the central institutional features of wage and employment determination in that economy. In other words, unless trade unionism is a mere epiphenomenon, the sort of model that is relevant for an economy where, for instance, there exists a sizable nonunion sector will not be the same as the one appropriate where few workers are unaffected by some collective bargaining agreement. At the risk of oversimplifying a rich variety of institutional detail, it is useful to distinguish three groups of national economies in terms of the extent and nature of their unionized sector: first, there are the economies of countries such as Britain, France, West Germany, and Italy where the nonunion sector is very small (even though union membership may not embrace most of the labor force) and where there is a mixture of industry-wide bargaining and of plant-level or company bargaining; second, there is the United States, Canada, and Japan where collective bargaining tends to be highly decentralized and where there exists a large nonunion sector; and, third, there are countries such as Sweden, Denmark, Norway, and Spain where confederations of trade unions and employers engage in bargaining that sets the pattern for virtually every agreement throughout the economy. The issues that arise in the macroeconomic modelling of wages and employment in these three types of economies are different and I discuss some of these issues in turn.

Aggregation

In an economy consisting of a number of independent unions and firms and

bargaining is decentralized, the most obvious way of going from the models in Sections II and III above to the macroeconomy is literally to aggregate over the bargaining units. However, at least for wages, even under a battery of stringent assumptions, the resulting aggregate equations bear little relationship to their micro underpinnings: normally the functional form for the macro wage equation will differ from the functional form of the micro wage equations even if the equations of all bargaining units themselves have the same form; moreover, the parameters of the macro equation will not be some simple weighted average of the micro equations' parameters, but will involve the parameters describing the relationship between the micro exogenous variables and their macro counterparts.^{15/} These problems are exacerbated when

the timing of collective bargaining negotiations in the different sectors is not synchronized so that contracts are revised and new wage agreements come into effect at different moments. Under these circumstances, there is no reason to expect any stability in the parameters of the sort of macro wage equation that is invariably specified, namely, one in which (changes in or the levels of) wages are related linearly to current and lagged values of aggregate exogenous variables and perhaps to lagged values of wages. The parameters of this macro wage equation will take on one set of values during one period of time and another set of values during another period.

This sobering conclusion is by no means original and is simply an application of standard arguments in the literature on aggregation. Its force can be mitigated (though major problems persist) if each union has the same objective function, as does each firm, and if the form of the solution to each bargain is the same, but such assumptions are hardly worth taking seriously.^{16/} What does deserve to be taken seriously are the general

equilibrium problems arising from the wage in one bargaining unit being a direct function of wages in other bargaining units. For many years labor economists have emphasized such interdependences (using metaphors such as "wage contours" or "orbits of coercive comparison" or "wage constellations") and one explanation offered for these relationships is that the wage objectives of one trade union depend upon the wages paid to the workers of some comparison trade union.^{17/} Such models are easy to construct. The hard part of any research on these wage interdependencies is not so much the estimation of equations that allow for such interdependencies, but discriminating between the hypothesis that these arise because each union's objectives are affected by other unions' wages and the hypothesis that correlated shifts in labor demand functions pull up wages in many sectors at approximately the same time and at almost the same rate. The latter hypothesis traces the cause of the wage increases in many industries to correlated shifts in the constraints rather than to the objective functions of the unions.

Where there is an important nonunionized sector of the economy, a macro wage equation must be derived not merely from aggregating the wage equations of each bargaining unit within the unionized sector of the economy, but also from the wage equations of each labor market in the nonunionized sector. The difficulties of doing this in a convincing fashion have been tacitly recognized by those who go no further than aggregate within each sector and thus who develop two sector models of the economy.^{18/} In most of these models, union wages are specified as a positive function of nonunion wages on the argument that trade unions set wages for their members to maintain a differential over nonunion wages. The nonunion sector is treated in these

models in different ways. In some, wages in the nonunion sector are a negative function of wages in the union sector simply because a higher union wage is assumed to release workers to the nonunion sector. In other research, employers in the nonunion sector forestall the unionization of their workers by ensuring that their workers' pay does not fall far behind that received by comparable unionized workers so that through this "threat effect" nonunion wages are specified as a positive function of union wages. The direction and size of these interactions between the wages in the union and nonunion sectors have been the subject of empirical research, but the results are distinctly inconclusive.^{19/} Surely, "threat effects" are of considerable importance in some markets and are completely irrelevant in others. Correspondingly, they are likely to be present during some periods and not in others. Aggregating over different labor market structures and fitting equations to a number of years yields results that may correspond to no labor market at any time.

Centralized Wage Setting

The models in Sections II and III hold out the greatest promise of meaningful econometric application at the macroeconomic level in those countries where confederations of trade unions and employers arrive at a wage agreement that the negotiators in every sector are recommended to follow although there may well be slight modifications in this basic wage increase in particular sectors. In fact, as is well known, through "wage drift" the effective rate of pay increase in such economies often diverges from that negotiated in the centralized bargains and, it is sometimes conjectured, subsequent wage increases scheduled at the economy-wide level may do no more than ratify earnings increases that have already taken place on the factory floor. There is a danger, therefore, of exaggerating the importance of the

economy-wide bargains in such countries and of understating the relevance of decentralized wage determination. Notwithstanding this drift phenomenon, there seems to be an understanding among observers of these economies that the centralized wage negotiations do exert an independent influence on the course of earnings over time. In this event there may be a genuine case for applying the single union-employer characterization in Sections II and III above to the economy as a whole.

Of course, the problems of defining well-behaved objective functions for each of the parties at this level of aggregation must be many times more formidable than they are for more homogeneous groups of workers and managements. Nevertheless, it would be worthwhile to ascertain how successful one can be in describing the movements of wages and employment at the macro level by a formulation inspired by the models in Sections II and III. The purpose of this exercise is to determine whether the sort of models that have proved useful in certain microeconomic settings have a similar value at the macroeconomic level. I have already indicated why, even with centralized wage agreements, there are good reasons to doubt their worth in macroeconomics--there are very serious aggregation and general equilibrium problems--but some demonstration of their empirical performance would contribute to an evaluation.

As was noted in Sections II and III, there is no single model that finds acceptance at the microeconomic level so, in this initial attempt, I have selected one of the models with which I am most familiar and I have applied it to describe the course of wages and employment in the manufacturing and mining sector of the Swedish economy over the 15 years from 1968 to 1982.^{20/} This was a very eventful period as far as Sweden's collective bargaining system was

concerned. From the early 1950's to the late 1960's, there was widespread satisfaction with the way the highly centralized system appeared to work. This has changed a good deal since then and, indeed, the system is now under severe pressures that are altering it fundamentally: in March 1983, the wage settlement in the engineering industry represented the first time in nearly 30 years that an important wage agreement was concluded outside the centralized wage setting procedures involving the confederations of unions and employers.

The following model characterizes the confederation of trade unions as having objectives defined over the average after-tax real wage level and over the level of employment and as being constrained in the simultaneous attainment of these two objectives by a tradeoff that is presented by employers' labor demand functions. Because the centralized agreements do not relate to the level of employment, there is a prima facie case for a model in which employment is set unilaterally by firms. On the other hand, although this formulation specifies a tradeoff between wages and employment when other factors are held constant, there is no effective ex post tradeoff if government policy operates on aggregate demand to nullify any employment-decreasing effects of the unions' wage policy. Insofar as the unions perceived this to be the government's policy and insofar as the government actually operated in this way, then the labor demand function does not operate as an effective restraint on the unions' wage demands. Hence the role of government macroeconomic policy in modifying the effective constraints on trade union behavior may disqualify the application at the aggregate level of the sort of behavioral model that can appropriately be applied at the microeconomic level.

Moreover it should be noted that this formulation of trade union

objectives ignores considerations that seem to have been of some importance in Sweden during the past 15 years. For instance, the unions have expressed concern not only for the average wage level but also for the wage structure and, in fact, wage differentials have narrowed appreciably. Although it is straightforward to modify the objective function below to accommodate this aspect of union goals,^{21/} I have not done so in this initial investigation of the performance of this model and this may well represent another shortcoming of the model estimated below.

Suppose the wage goals of the confederation of trade unions are gauged with respect to some reference level γ . In particular, if W_t stands for average money wages (before income tax) in manufacturing, mining, and quarrying in period t , L_t denotes employment in these industries in period t , i_t is the average tax rate on earnings in period t , s_t is the sales tax rate on consumer goods in period t , and P_t is the price of consumer goods before any indirect taxes in period t , then the trade unions' objectives in period t are specified as follows:

$$(8) \quad r_t = \left[\ln \left(\frac{(1 - i_t)W_t}{(1 + s_t)P_t} \right) - \gamma + u_{1t} \right]^\theta \left[\ln(L_t) + u_{2t} \right]^{1-\theta}.$$

The value of θ indicates the weight placed on supernumerary real after-tax wages relative to that placed on employment in the unions' objectives where these variables appear in their logarithmic form. Factors affecting unions' objectives that are unobserved to the economist are given by u_{1t} and u_{2t} . W_t is assumed to be set at a level that maximizes equation (8) subject to the constraint of employers determining employment according to a labor demand function that is linear in the logarithms of the variables:

$$(9) \quad (\ln L_t)^* = \alpha_0 + \alpha_1 \ln \left[\frac{(1 + v_t) W_t}{Q_t} \right] + \alpha_2 \ln \left(\frac{R_t}{Q_t} \right) + \alpha_3 \ln \left(\frac{I_t}{Q_t} \right) + \alpha_4 \ln Y_t + u_{3t}$$

where the asterisk denotes the optimal level of employment. Because of adjustment costs, actual employment in any period may differ from optimal employment as follows:

$$(10) \quad \ln L_t = \lambda (\ln L_t)^* + (1 - \lambda) \ln L_{t-1} + u_{4t}.$$

In equation (9), v_t is the payroll tax rate paid by firms,^{22/} Q_t is an index of producer prices,^{23/} R_t and I_t are the prices of industrial raw materials and of imports respectively, Y_t measures the real disposable income of

consumers, and u_{3t} represents variables affecting the demand for labor that are unobserved by the economist. The presence of the unobserved stochastic term u_{4t} in equation (10) implies that actual employment equals a weighted average of desired and lagged employment on average and not necessarily in each and every period. If R_t represents the prices of inputs substitutable in part for labor in production,^{24/} then $\alpha_2 > 0$. How the prices of all imports affect the demand for labor, if at all, depends upon whether these imports are mainly inputs in production and, as such, whether they are competitive or complementary with labor or they are mainly consumer goods and, as such, affect the derived demand for labor. These arguments suggest that α_3 is more likely to be positive than negative. The sign of α_4 is expected to be positive if labor is not an inferior input in production. By making α_0 a function of time, equation (9) can allow for trend-like growth in the efficiency of labor, but not being aware of evidence suggesting the presence of important changes in labor quality over the past 15 years in these

industries I have left α_0 as a constant. All the problems mentioned earlier in this section with respect to aggregation apply to the specification of equations (9) and (10).

If money wages, W , in period t maximize equation (8) subject to the tradeoff equations (9) and (10), then the following pair of equations may be derived:

$$(11) \quad \ln\left(\frac{(1 + v_t)W_t}{Q_t}\right) = \gamma(1 - \theta) - \theta\alpha_0\alpha_1^{-1} + (1 - \theta) \ln\left(\frac{(1 + v_t)(1 + s_t)P_t}{(1 - i_t)Q_t}\right) \\ - \theta\alpha_2\alpha_1^{-1} \ln(R_t/Q_t) - \theta\alpha_3\alpha_1^{-1} \ln(I_t/Q_t) - \theta\alpha_4\alpha_1^{-1} \ln Y_t \\ - \theta\alpha_1^{-1}(1 - \lambda)\lambda^{-1} \ln L_{t-1} + \varepsilon_{1t}$$

$$(12) \quad \ln L_t = \lambda(1 - \theta)(\alpha_0 + \alpha_1\gamma) + \lambda\alpha_1(1 - \theta) \ln\left(\frac{(1 + v_t)(1 + s_t)P_t}{(1 - i_t)Q_t}\right) \\ + \lambda\alpha_2(1 - \theta) \ln(R_t/Q_t) + \lambda\alpha_3(1 - \theta) \ln(I_t/Q_t) + \lambda\alpha_4(1 - \theta) \ln Y_t \\ + (1 - \lambda)(1 - \theta) \ln L_{t-1} + \varepsilon_{2t}$$

where ε_{1t} and ε_{2t} are different linear combinations of the unobserved components u_{1t} , u_{2t} , u_{3t} , and u_{4t} . These equations yield the following comparative static implications. If increases in R_t , I_t , and Y_t shift the labor demand function to the right, then both money wages (W_t) and employment (L_t) will rise. Correspondingly, an increase in the payroll tax rate, v_t , shifts the labor demand function to the left and causes a reduction in W_t and L_t . Increases in the income tax rate, i_t , in the sales tax rate,

s_t , and in the consumer price index, P_t , induce a rise in money wages and a fall in employment. As far as the unions' objective function parameters are concerned, increases in θ and γ raise wages and reduce employment. An increase in the producer price index, Q , may result in higher or lower money wages, but whatever the sign of this effect it will be opposite to the sign of the effect of an increased Q on employment.

On the assumption that ϵ_{1t} and ϵ_{2t} are contemporaneously correlated and are drawn from a multivariate normal distribution, equations (11) and (12) were estimated by maximum likelihood using quarterly data for Swedish mining and manufacturing from the first quarter of 1968 to the fourth quarter of 1982. Means and standard derivations of the variables used in the analysis are provided in Table 2. The resulting parameter estimates (with asymptotic standard errors in parentheses) are as follows:

$$\hat{\theta} = \begin{matrix} 0.351 \\ (0.090) \end{matrix} ; \hat{\gamma} = \begin{matrix} -1.594 \\ (0.072) \end{matrix} ; \hat{\lambda} = \begin{matrix} 0.530 \\ (0.080) \end{matrix} ;$$

$$\hat{\alpha}_0 = \begin{matrix} -0.149 \\ (0.193) \end{matrix} ; \hat{\alpha}_1 = \begin{matrix} -0.350 \\ (0.167) \end{matrix} ; \hat{\alpha}_2 = \begin{matrix} -0.697 \\ (0.440) \end{matrix} ;$$

$$\hat{\alpha}_3 = \begin{matrix} -0.153 \\ (0.175) \end{matrix} ; \hat{\alpha}_4 = \begin{matrix} 1.267 \\ (0.439) \end{matrix} ; \hat{\ell} = 238.25 ,$$

where $\hat{\ell}$ denotes the maximized value of the likelihood function. The estimate of θ is significantly different from both zero and unity indicating that both real wages and employment have figured in the trade unions' objectives. The estimated value of γ is only slightly less than the mean value of $\ln[(1 - i_t)W_t/(1 + s_t)P_t]$ over this period^{25/} and it bears interpretation in terms of a reference real wage level (in logarithms) which the unions use as a gauge for their real wage objectives. The estimate of λ implies that 95

percent of any adjustment of employment to its optimal level is accomplished within a year. Of the parameters of the labor demand function, only those associated with wages (α_1) and with disposable income (α_4) appear to be significantly different from zero by conventional criteria and both of these have their expected signs. The elasticity of the demand for employees with respect to real wages is estimated to be -0.35. Although some of these parameter restrictions may appear encouraging with respect to the application of this simple model to the Swedish manufacturing and mining sector, it should be noted that the parameter restrictions embodied in equations (11) and (12) are unambiguously rejected on a likelihood ratio test compared with a general ~~linear-in-the-logarithms~~ specification of these equations.^{26/}

Table 2

Clearly more work needs to be performed on the application of this model to the Swedish manufacturing and mining sector^{27/} and I hope to report this further research on another occasion. As they stand at the moment, the results are hardly strong endorsement of the particular model proposed. There are two general classes of explanations for this. The first would account for the poor performance of this model in terms of the particular shortcomings in the implementation of this model. For instance, wage drift has not been modelled explicitly, the discontinuous nature of the wage agreements has been ignored,^{28/} no role has been permitted for incorrect and perhaps inconsistent price expectations,^{29/} and these wage and employment equations need to be integrated into a larger system of equations that account for the determination of incomes and prices. There is no reason why these

Table 2

Descriptive Statistics on Variables Used in Analysis of Wages and
Employment in Swedish Manufacturing and Mining Sector, 1968-1982

<u>Variable</u>	<u>Mean</u>	<u>Standard Deviation</u>
W, average hourly earnings in kronor	22.190	9.507
L, numbers employed (in millions)	1.092	0.042
v, payroll tax rate	0.287	0.105
i, average income tax rate	0.264	0.009
s, sales tax rate	0.124	0.002
$(1 - i)W/(1 + s)P$	0.210	0.019
$(1 + v)W/Q$	0.414	0.063
R/Q, industrial raw materials prices divided by average revenue received by firms	0.978	0.055
I/Q, import price index divided by average revenue received by firms	1.097	0.103
Y, real disposable income	0.635	0.056

Notes: The producer price index, Q, describes the prices of ores, minerals, and manufactured goods produced in Sweden for domestic consumption and for export. R is given by a wholesale price index for industrial raw materials and supplies. I is an index of the prices of all imported goods. Y is disposable income deflated by an index of consumer prices. Y_t is measured as the average of Y in the current quarter and in the previous three quarters. It was very difficult to construct series for the three tax rates and an appendix to this paper describes how this was managed. All the data (except for disposable income and the income tax rate) were taken from issues of the Monthly Digest of Swedish Statistics. The disposable income series is derived from issues of National Institute of Economic Research, The Swedish Economy, Stockholm. The tax data are described in the appendix.

modifications and extensions (as well as others) cannot be made to the model investigated here and it could be that the model's empirical performance will improve if these matters are addressed appropriately.

The second class of explanations for the inadequacy in the model estimated above has to do with the difficulties in constructing and estimating any macroeconomic model that is designed to identify meaningful structural parameters as distinct from one aimed at merely describing empirical regularities. It could be the case that an economy's diverse and complex production and consumption behavior somehow results in relatively simple aggregated production and consumption equations whose structural parameters reveal a stability over time at the same time that the relative importance of the underlying microeconomic units is undergoing substantial change. This is possible, but not probable.

V. Conclusions

The past decade has witnessed a considerable revival of interest in behavioral models of trade unionism. Many of these models adopt similar assumptions about trade union objectives or about the manner in which wages are determined in unionized markets. In particular, there is widespread (though not universal) use of the expected utility hypothesis to characterize trade union objectives and many economists presume wage and employment outcomes that lie on the contract curve. These agreements in model building have not arisen because of persuasive evidence of the empirical relevance of these modelling assumptions, but because of the theoretical convenience of certain simplifying assumptions and because of their conformity with analogous assumptions in other areas of economics (where, quite often, they also lack

empirical foundation). In other words, it is ideology and the social aspect of economics inquiry--not science--that account for the similarity in much of the work on behavioral models of unionism. In fact it should be evident from this review of the microeconomic research on behavioral models of trade unionism and from the difficulties raised by their macroeconomic application that our knowledge of the way in which wages and employment are determined in unionized labor markets is meagre. In view of this, it would seem ill-advised to place much reliance on these models for the purpose of macroeconomic policy evaluation and prescription.

Appendix

The purpose of this appendix is to describe how the tax rate observations were derived. The payroll tax rate, v_t , was constructed as follows. According to Holmlund (1983), v_t was 0.402 in 1979. In this year W_t was 30.295 kronor so the implied unit labor costs in kronor in 1979 were 42.472. The published index number of labor costs (1973 = 100) in 1979 is 225.0. Hence in 1979 the ratio of labor costs in kronor to the index number of labor costs is $42.472/225.0 = 0.1888$. A series on unit labor costs in kronor consists of multiplying the published index number of labor costs by 0.1888 and the payroll tax rate is the ratio of these labor costs to W minus unity. My derived series for v_t moves closely with Holmlund's although it is not identical to his.

The sales tax rate, s_t , was constructed as follows. In 1971, the ratio of gross domestic product (GDP) at purchasers' value to GDP at factor cost is 1.1525 so 15.25 percent is an estimate of the net sales tax rate in that year. (See OECD (1984), Table A.) In 1971 the index number of consumer

prices (1980 = 100) is 44.475 and the net price index (1980 = 100) is 43.350. So after conversion by a factor x , the ratio of consumer prices to net (i.e., before indirect taxes) prices must equal 1.1525 or $(44.475/43.350)$ $x = 1.1525$. This implies $x = 1.1233$. Hence, $1 + s_t$ in any other period is 1.1233 times the ratio of the consumer price index to the net price index in that period.

To derive a series on the income tax rate, i_t , I made use of information published by the OECD in the series The Tax/Benefit Position of a Typical Worker in OECD Member Countries. For a married couple with 2 children, the wife not working and the husband paid the average production worker's earnings, these OECD publications list disposable income in Sweden as a fraction of gross earnings as 0.735 in 1972, 0.740 in 1973, 0.751 in 1974, 0.734 in 1975, 0.718 in 1976, 0.749 in 1978, 0.740 in 1979, 0.7508 in 1980, 0.7355 in 1981, and 0.7211 in 1982. These values take into account tax credits and transfers and income tax paid to local governments. Not having information for the other years, I heroically assumed a value of 0.733 in 1977 (i.e., a simple average of 1976 and 1978) and a value of 0.735 in the years before 1972 (i.e., the same value as for 1972). The average tax rate, i_t , is unity minus these values of disposable income as a fraction of gross earnings.

Footnotes

- * In writing this paper, I have benefitted from various comments on a previous draft given at the Conference on Trade Unions, Wage Formation, and Macroeconomic Stability. The comments of Lars Calmfors, Bertil Holmland, and George Johnson were particularly useful. The research assistance of Sarah Lane is gratefully acknowledged.
- 1/ It figured in theoretical work on trade union behavior by Calmfors (1982), McDonald and Solow (1981), and Oswald (1982), among others.
- 2/ The device used by American craft unions to handle the movement of its members to different cities was the "travelling card." For a fascinating and thorough account of the development of the card, see Ulman (1955).
- 3/ This case is considered by McDonald and Solow (1981) who describe a union that behaves in this way as a "commune."
- 4/ For instance, in the collective bargaining contracts in the U.S. rubber, automobile, and farm equipment industries in the 1970's, the unions were topping up the state unemployment benefits received by temporarily laid off workers to such an extent that some senior employees preferred to be laid off than to continue working. This is not typical of the U.S., however. Certainly before the development of state unemployment compensation, many trade unions paid out benefits to its out-of-work members. See Kennedy (1908).
- 5/ These linkages are weak because the degree of experience rating in each firm's payroll tax rate is markedly incomplete (i.e., the unemployment compensation paid to a firm's former employees is not fully charged to that firm in the form of higher taxes) and whether the incidence of the payroll tax for unemployment insurance is borne by employed labor is not known with any confidence.
- 6/ This information is restricted to those collective bargaining contracts that cover 1,000 workers or more and it comes from U.S. Department of Labor (1972). It should be noted that some seniority clauses which are associated with hours of work can be construed as worksharing devices. In its 1973 contract, the United Auto Workers secured clauses that permit a worker with 35 years of experience to retire irrespective of his age. In 1963 the United Steelworkers negotiated an agreement with the major steel firms that secured for senior workers 13 week vacations (with pay) at five-year intervals.
- 7/ See Henle (1976).
- 8/ The only state permitting the payment of unemployment compensation to workers on "short time" (i.e., working fewer hours per week than the standard hours) is California which initiated a scheme in 1978 that resembles those in West Europe. In these countries the state stands

ready to make up at least part of the difference between a worker's short-time pay and his regular pay and consequently short time is frequently used to allocate the reduced demand for manhours among a given number of employees. On the various schemes in California and West Europe, see Best (1981), Rothschild (1978), and Schmid (1978) and on Canada's experiments see Reid (1982).

- 9/ See, for instance, Kramer (1973) or Blair and Crawford (1984). Farber specified fringe benefits in addition to money wages in the median voter's utility function.
- 10/ Also see Kahneman and Tversky (1979), Loomes and Sugden (1982), and especially Machina (1983).
- 11/ For instance, suppose we maintain the hypothesis that union-management contracts are efficient. Then if unions maximize rents and firms maximize net revenue, the contract curve will be vertical and the correlation between wages and employment (holding constant the variables determining the location of the contract curve) will be zero. In fact, Ashenfelter and Brown (1983) report that the partial correlation between the wages and employment of typographers is significantly negative and this is a robust finding that survives many different ways of specifying the relationship. This result implies that unions do not maximize their rents or that newspaper firms do not maximize their net revenues or both. This interpretation of Ashenfelter and Brown's work differs from their own. Compared with my interpretation, Ashenfelter and Brown switch the maintained and the research hypotheses: they maintain the hypothesis that unions maximize rents and firms maximize net revenues; on this assumption, the partial correlation between wages and employment indicates whether or not the parties are on the contract curve. The presence of a significant correlation between wages and employment incline Ashenfelter and Brown to conclude that the collective bargaining contracts are not efficient. By contrast, my argument above concludes that the parties do not maximize rents.
- 12/ In all of the papers listed except one, it is presumed that the collective bargaining agreements result in employment being set such that the marginal revenue product of labor equals the wage; for MacCurdy and Pencavel's results, the union and management are on their contract curve. (Section III below contains an elaboration of this.)
- 13/ Carruth and Oswald (1983) and Farber (1978a, 1978b) do not calculate the value of the elasticity of substitution and there is insufficient information in their papers for me to determine the standard errors of this parameter. To illustrate the imprecision with which σ is estimated for typographers, my augmented addilog estimates of 0.71 and 0.19 come with standard errors of 0.33 and 0.06 respectively. Note that if the union maximized rents, σ would be given by $1 - \left(\frac{1}{2}\right)(\bar{w}/w)$ which is less than unity.

- 14/ Equation (7) also holds in Nickell's (1982) model where the union and the employer bargain over the wage rate (a generalized Nash solution concept is used) and then the employer determines employment unilaterally.
- 15/ Suppose over a period of time the reduced form wage and employment equations in each bargaining unit i are conveniently linear in variables and parameters: $w_{it} = a_i + b_i X_{it} + e_{it}$ and $L_{it} = c_i + d_i X_{it} + u_{it}$ where X_{it} is a vector of exogenous variables relevant to bargaining unit i and e_{it} and u_{it} are error terms representing omitted variables affecting wages and employment respectively. Let us (implausibly) suppose that these error terms have the most convenient properties, namely, e_{it} and u_{it} are distributed independently of one another and also independently of the values of the error terms in other sectors. Also suppose that aggregate employment, $L_t = \sum_i L_{it}$, does not change over time. Then forming a weighted average of wages in different sectors, $w_t = \sum_i (L_{it}/L) w_{it}$, will yield an equation in which the values of each sector's X_{it} and each sector's X_{it}^2 will appear as determinants of w_t , the macro wage level. In fact, of course, macro wage equations do not use each sector's exogenous variables as regressors, but some average or aggregate of these variables. For instance, let X_{it} be the price of raw materials relevant to sector i and let X_t be an economy-wide index of raw material prices where the relationship between the micro and macro price variables may be expressed as $X_{it} = \ell_i + m_i X_t + v_{it}$. Again assume the most stringent and convenient properties for the error term v_{it} . A relationship between macro wages and macro raw material prices is thus derived. However, it is not linear in the variables. Nor are the coefficients of this equation some weighted average of the coefficients in the micro wage equation (a_i and b_i), but they interact in a non-trivial fashion with the micro employment parameters (c_i and d_i) and with the parameters describing the relationship between each sector's X_{it} and the macro X_t (ℓ_i and m_i).
- 16/ Even for a group of workers as homogeneous as the typographers, I found substantial diversity in the objectives of the different union locals (Pencavel 1984a).
- 17/ Suppose, for instance, that union 1 possesses objectives that may be described by a Stone-Geary function $\Gamma_1 = (w_1 - \gamma_1)^{\theta_1} (L_1 - \delta_1)^{1-\theta_1}$, but where the reference parameter γ_1 is a linear function of wages paid to workers of union 2: $\gamma_1 = a_1 + b_1 w_2$. Suppose also that union 2

possesses similar objectives and its wage reference parameter is a linear function of w_1 . Finally suppose that in each labor market wages are set to maximize the value of the union's objective function subject to a linear labor demand function. Under these circumstances each union's optimal wage is a linear function of the wage set by the other union. If each behaves in Cournot-like fashion, the linear reaction functions may be solved for the equilibrium pair of wages in the two sectors. The Cournot solution seems only a plausible characterization when there are many unions and the costs of collaboration among the unions are high. Other solutions should be obvious by analogy with the literature on oligopoly in the product market. Also see Oswald (1979).

- 18/ Of course, this does not avoid the formidable problems of aggregation within each of the two sectors.
- 19/ For example, look at the different conclusions reached from analyzing virtually the same (aggregate) data in Flanagan (1976), Johnson (1977), and Vroman (1982). For a different procedure, see Mehra (1976).
- 20/ After a first draft of this paper was written, I became aware of the paper by Hersoug, Kjaer, and Rodseth (1984) which (to the best of my knowledge) represents the only other attempt to characterize the course of wages in a Nordic country by the sort of structural model outlined below.
- 21/ For instance, a statistic summarizing the dispersion of wages can be included as a separate argument in equation (8) or the levels of wages at different points in the frequency distribution of wages can be entered separately. On movements in wage differentials in recent years, see OECD (1984), pp. 15-16.
- 22/ The payroll tax rate has grown from approximately 12 percent in 1968 to around 40 percent in 1982. See Holmlund (1983).
- 23/ The index of producer prices, Q_t , is specific to the manufacturing and mining sector of the economy while the index of consumer prices, P_t , relates to a representative basket of all goods consumed. Imports enter into the calculation of P_t and some exports into the calculation of Q_t .
- 24/ I could not locate time-series observations on a rental price of for machinery.
- 25/ This implies that, for some values of $\ln[(1 - i_t)w_t/(1 + s_t)P_t]$, r_t may not be defined (depending upon the values of u_{1t}). This is by no means an uncommon finding in the application of the Stone-Geary function in consumption analysis.

26/ The maximum likelihood estimates of the unconstrained version of equations (11) and (12) are as follows:

$$\begin{aligned} \ln((1 + v_t)W_t/Q_t) = & -0.873 + 0.630 \ln((1 + v_t)(1 + s_t)P_t/(1 - i_t)Q_t) \\ & (0.073) \quad (0.126) \\ & - 1.566 \ln(R_t/Q_t) + 0.059 \ln(I_t/Q_t) + 1.904 \ln Y_t \\ & (0.404) \quad (0.232) \quad (0.195) \\ & + 0.131 \ln L_{t-1} + \hat{\epsilon}_{1t} \\ & (0.216) \\ \ln L_t = & 0.011 - 0.108 \ln((1 + v_t)(1 + s_t)P_t/(1 - i_t)Q_t) \\ & (0.039) \quad (0.056) \\ & + 0.336 \ln(R_t/Q_t) - 0.192 \ln(I_t/Q_t) + 0.015 \ln Y_t \\ & (0.257) \quad (0.142) \quad (0.076) \\ & + 0.808 \ln L_{t-1} + \hat{\epsilon}_{2t} \\ & (0.097) \end{aligned}$$

where estimated standard errors are in parentheses and where the maximized value of the likelihood function is 290.72.

27/ This work should include a careful examination of the serial correlation pattern of the residuals, something that to date I have not been able to address satisfactorily. The estimated values of ϵ_{1t} and ϵ_{2t} from fitting equations (11) and (12) reveal positive serial correlation of more than the first-order.

28/ The nature of the problems in estimating wage equations when wages change discontinuously is outlined in Pencavel (1982).

29/ That is, the wage negotiated today applies to some future periods in which prices are not yet known with certainty. Hence the P_t in equation (8) should represent the prices expected (at the time of negotiations) by the unions to prevail in period t . The firms' employment decisions in equation (9) may also be made with respect to the prices expected to prevail in the future.

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