

An Economic Theory of the Open Shop Trade Union

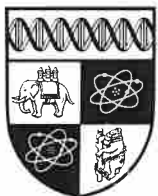
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Abstract

There has been significant interest recently both in the empirical investigation of the determinants of trade union membership, in the UK and elsewhere, and in the theoretical analysis of the economic effects of the closed shop trade union. However, there is little rigorous microeconomic explanation of union membership which is relevant for much of the UK and similar labour markets where the 'open shop' union is prevalent. This paper attempts to overcome the free-rider problem of explaining union membership in the open shop. We show that stable intermediate union density is a possible equilibrium outcome in a generalised social custom model. We argue that the approach has important empirical implications and is able to explain a number of otherwise puzzling features of union membership. We also analyse the simultaneous determination of wages and union membership, deriving a number of interesting comparative static results. In particular, we find that there is a critical or threshold level of union density [and an associated critical wage level] in the establishment below which membership will unravel to a zero level from which it will not then recover easily. We find also that the nature of the dependence of union power on union membership is a crucial determinant of the level [and stability properties] of membership and of the comparative static outcomes.

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1. Introduction

The key importance of wage determination processes in macroeconomic models coupled with discussions of the relevance of institutional design and policy have put economic theories of the trade union centre stage in current economic debate [see Alogoskoufis and Manning (1991), Oswald (1986) and Layard and Nickell (1986)]. The most general of the union-firm bargaining models in common use view the bargain as taking place between a profit-maximising firm and a utility-maximising trade union. Within this framework, particular models vary in their assumptions either about union preferences or about the degree of union power over the bargained variables. Manning (1987) has shown how the most popular models - monopoly union, right-to-manage and efficient bargaining - emerge as special cases within a sequential bargaining framework. However, even this latter most general framework adopts the implicit assumption that the firm confronts a union which carries the force of a closed shop and which bargains on behalf of a fixed level of membership which always exceeds the employment level in the bargained outcome. Carruth and Oswald (1987) have shown that if employment exceeds membership then union preferences, and hence wage-employment outcomes, are affected. In the present paper, we move away from both the fixed membership and closed shop assumptions to develop a model in which the level of union membership at the establishment is determined endogenously.

Previous models have attempted to explain the level of union membership in the aggregate economy. There has been a recent and extensive empirical literature on this issue¹. Grossman (1983) develops a theoretical model to explain the simultaneous determination of wages and [aggregate] union membership. This model has been adopted by Disney and Mudambi (1989) and provides the basis for their empirical work on aggregate UK union density. The Grossman model, however, is built on the assumption of an aggregate labour market which can be dichotomised neatly into a union and a non-union sector. This segmentation is unsatisfactory in labour markets, such as that in the UK, where it is not the case that establishments can be partitioned into those, on the one hand, in which unions are not recognised and there are no union members [a non-union sector] and those, on the other hand, in which there is a union closed shop with full membership [a - monopoly - union sector]. This emerges quite clearly from consideration of Tables 1 and 2 below².

The final column in Table 1 shows that of the 854 private sector establishments selected from the 1984 WIRS data set, union density among manual workers was either zero or

¹ See Carruth and Disney (1988), Disney (1990), Freeman and Pelletier (1990) and, for a discussion of international patterns of divergence, Freeman and Blanchflower (1990) and Freeman (1989).

²We are grateful to Paul Gregg for the data as presented in this form. The tables come from joint work between Naylor and Gregg.

100% in 185 and 309 establishments, respectively. Thus in 42% of cases union density is at some intermediate level. There are a number of interesting aspects to the Table calling for closer attention. First, the presence of a closed shop does not imply that union density is necessarily close to 100%. In the case of very low membership, at least, this is likely to be attributable either to the closed shop explicitly covering only some groups of an establishment's manual workers, or to part-time workers not joining the union. Second, the Table demonstrates how density can be high [in some cases up to 100%] even in establishments where unions are not recognised for bargaining purposes. Third, for manual workers across establishments where there is union recognition but neither a closed shop nor a recommendation by management that workers join a union, the modal level of union density is over 90% and the median is over 50%, but each density level is well-represented in the distribution.

Table 1 Union Density by Bargaining Arrangement.
(Manual Workers in Private Sector Establishments).

Union Density (D)	Non-Recog ³	Recog	Manrec	Shop	Total
D=0	185	0	0	0	185
0<D<10	20	14	0	1	35
10≤D<20	10	8	2	0	20
20≤D<30	11	12	1	1	24
30≤D<40	2	10	2	2	16
40≤D<50	4	21	4	1	30
50≤D<60	2	16	1	1	20
60≤D<70	4	28	4	3	39
70≤D<80	1	31	11	7	50
80≤D<90	0	10	6	9	25
90≤D<100	2	37	31	30	100
D=100	4	14	74	217	309
	--	--	--	--	--
	245	201	136	272	854
	--	--	--	--	--

Source: WIRS, 1984.

For non-manual workers, it is also true that each density level is well-represented across establishments where unions are merely recognised. However, mode and median density levels are lower than for manual workers. Table 2 shows the data for non-manuals.

³Non-Recog refers to establishments where unions are not recognised for bargaining purposes. Manrec signifies that management recommends membership and Shop denotes the presence of a closed shop, either pre- or post-entry.

Table 2 Union Density by Bargaining Arrangement.
(Non-Manual Workers in Private Sector Establishments).

Union Density (D)	Non-Recog ⁴	Recog	Manrec	Shop	Total
D=0	393	0	0	0	393
0<D<10	11	20	1	0	32
10≤D<20	14	21	2	3	40
20≤D<30	5	31	4	2	42
30≤D<40	6	22	6	1	35
40≤D<50	5	41	7	1	54
50≤D<60	3	38	16	8	65
60≤D<70	1	26	9	8	44
70≤D<80	0	30	15	16	61
80≤D<90	0	13	15	13	41
90≤D<100	2	14	13	9	38
D=100	5	10	18	27	60
—	—	—	—	—	—
	445	266	106	88	905
	—	—	—	—	—

Source: WIRS, 1984.

We conclude from this evidence that it is not valid to depict the British labour market as dichotomised neatly into union and non-union sectors. Nor, from the data, does it seem reasonable for economists to develop economic theories of trade unions under the exclusive assumption of the closed shop, as is typically the case. If we take the open shop to include establishments where unions are recognised and where there may or may not be a management recommendation on membership, but where there is no closed shop, then we can see from Table 1 that for manual workers 55% of union shops are open and 45% are closed. For non-manual workers, 81% of union shops are open and 19% closed. The challenge for the economist, then, is to develop a theory of the trade union which allows for the possibility of the open shop union. This is given greater importance as legislation is passed to limit the extent of the closed shop.

The specific problem for the economist is to explain why any individual would join a trade union in the face of the free-rider incentive not to join the union. Given that any union-negotiated wage accrues both to union members and to non-members in the workplace, the wage outcome is a public good and hence the individual's dominant strategy is to free-ride. Yet, as is clear from Tables 1 and 2, whilst free-riding probably does occur, it is not all-pervasive: open shops do exist and are characterised by varying degrees of union density. Given this variation it is surprising that economists have had relatively little to say about the union open shop. This concern is likely to be relevant for a number of

⁴See previous footnote.

European economies, especially for those in which coverage of union-negotiated pay deals exceeds membership. Further, wherever there is local negotiation, the level of union density in the establishment is likely to have important implications for union bargaining power and thereby influence the union wage mark-up and the pattern of union strike activity, amongst other things. For example, in the extreme case where membership is close to zero it is likely that the union will be unable to influence the wage outcome. We return to this point in Section 5 of the paper.

In order to escape the free-rider problem in circumstances characterised by the prisoners' dilemma Olson (1965) argued that collective action will occur only if there is either compulsion [analogous in our context, perhaps, to the pre-entry closed shop] or an incentive private good. Booth (1985) interprets the incentive private good as being the 'reputation' utility that derives from complying with a social custom of membership. This idea stems from Akerlof (1980) who defines a social custom as "an act whose utility to the agent performing it in some way depends on the beliefs or actions of other members of the community." In the context of union membership the social custom can be best thought of as urging workers not to take a free-ride. The Booth model is able to show that a union can exist despite the potential free-rider problem. However, the only stable non-zero level of union density occurs when everyone joins the union. There is no stable intermediate equilibrium level of density, which means that many of the cases appearing in Tables 1 and 2 remain unexplained. The reason for this result lies in the assumption that workers are homogeneous with respect to their sensitivity to the reputation effects. This has been demonstrated by Naylor (1989) in the context of strike solidarity⁵ and Naylor (1990) for the general case of collective action. The purpose of the current paper is to develop an economic theory of the open shop trade union, compare its properties against the empirical evidence, investigate the implications for policy and future trends in union density and explore the links between membership and wages.

The plan of the rest of the paper is as follows. In Section 2 we develop a generalised social custom model of trade union membership. In Section 3 we examine the stability properties of the model and derive some comparative static results and in Section 4 we discuss the empirical content of the model. In Section 5 we examine some extensions of the basic model. In particular, we consider the endogeneity of union membership and the level of wages in order to offer an alternative to the closed shop, fixed membership framework of previous models.

Our most significant finding is that there is some threshold level of membership [and associated wage mark-up] below which there cannot be a non-zero stable equilibrium. Furthermore, zero membership is always a stable equilibrium outcome. Hence, it follows that there is a discontinuity which has major implications for current discussions about public policy, management responses to unions and about the predicted behaviour of union

⁵On which issue also see the interesting discussion in Varoufakis (1987).

membership over the business cycle. For example, as the membership level in an establishment declines, for exogenous reasons, it will approach the threshold level and suddenly jump to zero. Furthermore, the reverse effect of jumping from a zero level of unionisation to some positive level will not occur spontaneously. Thus, there is an asymmetric or ratchet effect on union membership. For membership to return to previous levels when exogenous changes disappear there may need to be a costly campaign by the union in order to regenerate self-sustaining membership levels. If this is correct, then whilst the aggregate union density level may be downwardly flexible, in the UK at least, it may well turn out to be "upwardly sticky". The analysis also suggests an incentive for firms to re-allocate capital to new establishments and hence adds an important dimension to Freeman's discussion of the influence of management opposition on union density. Finally, we find also that the nature of the dependence of union power on union membership is a crucial determinant of the level [and stability properties] of membership and of the comparative static outcomes.

2. The basic model

The model attempts to explain how the union membership decisions of individual workers are influenced by reputation effects in the establishment. Reputation-derived utility accrues to workers who adhere to a social custom invoking workers to join a trade union rather than to free-ride. Individual workers are assumed to be heterogeneous with respect to their sensitivity to reputation effects. We are able to show stable equilibrium levels of union membership in the workplace. The model is a generalisation of that used in Naylor (1989) in the context of strike solidarity. Here we allow for a flexible functional form and for the possibility that individuals acquire reputational benefits from non-union membership.

Let an individual's preferences be described by:

$$U_i = U(y) + V(\mu, \varepsilon_i)$$

The preferences are separable and the first term is a strictly increasing concave function of income, y . The second term represents utility gained from conforming to a social custom; whether the custom is membership or non-membership is immaterial as we shall allow for reputation effects to accrue within both conforming and non-conforming groups. The utility gained is dependent on a taste parameter, ε , which describes an individual's benefits from conforming to group behaviour. We assume $V(.,0) = 0$ and $V(.)$ increases in ε . The parameter μ represents the proportion of the population conforming to the social custom and we assume also that $V(.)$ increases in μ . Using subscripts to denote derivatives, we

also assume $V_{12} \geq 0$; that is, an increase in μ generates a larger increase in utility the larger is ϵ .

As we are concerned with union membership, let μ be the proportion of the population who join the trade union at the establishment and, hence, $1-\mu$ do not join. Let w be the wage rate (which is independent of the individual's union status because of the public goods characteristics of the wage) and let d be the net pecuniary cost of union membership. The payoffs from membership and non-membership are as follows.

$$U_i^J = U(w - d) + V(\mu, \epsilon_i) \quad (\text{membership})$$

$$U_i^{NJ} = U(w) + V(1 - \mu, \epsilon_i) \quad (\text{non-membership})$$

An individual is indifferent between joining and not joining a union if $U_i^J = U_i^{NJ}$, or

$$U(w) - U(w - d) = V(\mu, \epsilon_i) - V(1 - \mu, \epsilon_i) \quad (1)$$

i.e.,

$$Z_i = U_i^J - U_i^{NJ} = 0.$$

From our assumptions on $V(\cdot)$ it is clear that the solution to (1) defines a strictly decreasing schedule in (μ, ϵ) - space. As μ tends to 0.5 from above the RHS of (1) tends to zero, hence successively higher values of ϵ are necessary to preserve equality. The RHS of (1) increases in ϵ_i because as $V_{12} \geq 0$ and $\mu \geq 1 - \mu$ it must be the case that as ϵ increases the first term rises by more than the second declines. We can graph this relationship, as demonstrated by the decision schedule in Figure 1.

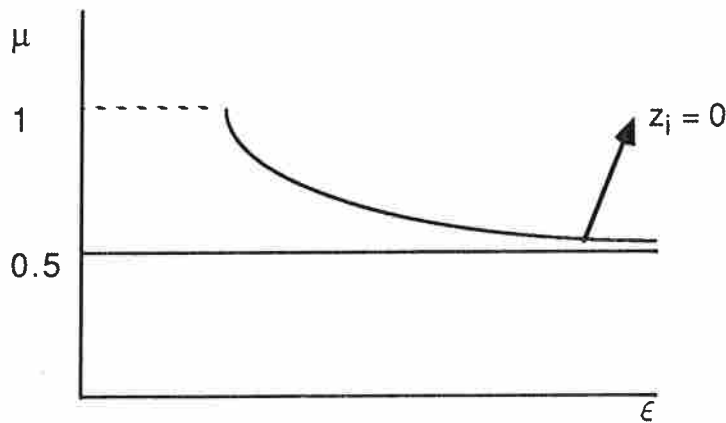


Fig. 1. The decision schedule

Workers are heterogeneous with respect to their sensitivity to reputation-derived

utility. We assume that the characteristic ϵ has a distribution described by a distribution function, $F(\epsilon_i)$, on the interval $0 \leq \epsilon_i \leq \epsilon_1$. Then we can represent in Figure 2 the ϵ -distribution schedule. It emerges as a property of the model that if there are both members and non-members in the population (i.e., $0 < \mu < 1$), then the latter group consists of individuals with the lower values of ϵ . When $\mu = 0.25$, for example, the group of joiners is represented by the highest quartile in the $(0, \epsilon_1)$ interval.

We can now investigate the equilibrium properties of the model. Consider points m, n, p and q in Figure 2⁶.

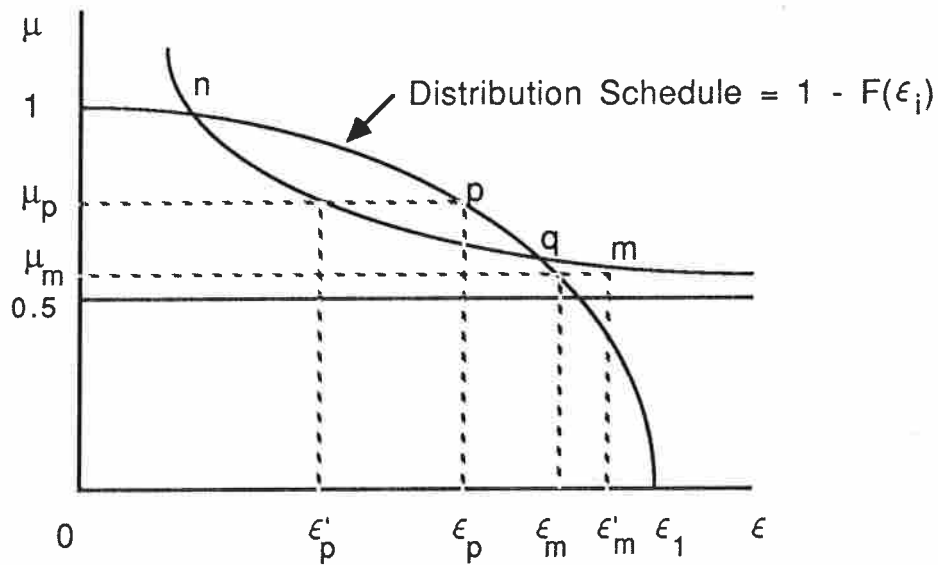


Fig. 2. Decision and distribution schedules.

At point p in Figure 2 there are μ_p joiners in the union, for whom $\epsilon_p \leq \epsilon_i \leq \epsilon_1$. The position of the decision schedule tells us that any individual with $\epsilon_i \geq \epsilon'_p$ will prefer to join the union. Point p, then, does not represent an equilibrium, as those non-joiners for whom $\epsilon_i > \epsilon'_p$ would prefer to join the union. Our assumption is that membership will grow in this situation. Similarly, point μ_m does not constitute an equilibrium level of union membership: of the μ_m joiners there is a proportion for whom $\epsilon_i < \epsilon'_m$, i.e., less than the density level needed to sustain their membership. From point m, then, we would expect membership to fall. It becomes clear that the [locally] stable equilibria in Figure 2 are at

⁶We assume that the Distribution Schedule can be described by a concave schedule in Figure 2. In subsection 5.2 we relax this assumption and allow for convex ranges of the Distribution Schedule.

point n, to which membership falls from unity and rises from levels such as μ_p , and at $\mu = 0$, to which membership falls from levels such as μ_m . Point q also represents an equilibrium, in the Nash sense that no-one would have an incentive to change their behaviour if, for some reason, membership happened to be at this level. But it is not a stable equilibrium as only a small drop in membership is necessary to induce density to unravel to zero, and only a small rise would generate increasing membership to point n.

The membership level at point q, μ_q say, represents a critical or threshold level of membership which a union must achieve in order for union membership to be self-sustaining. If this critical level is exceeded then membership will rise to reach the level, μ_n say, associated with point n in Figure 2. From this it is clear that both the equilibrium and the threshold levels of membership will depend upon the parameter values in the decision and distribution schedules. We now consider how the equilibria are affected by changes in the parameters.

First, a shift to the right of the ϵ -distribution in the sense of first-order stochastic dominance [see Milgrom (1981) for a discussion] would raise the stable equilibrium level of membership [point n in Figure 2] and reduce the threshold level of union density. This shift to the right would be a reflection of greater sensitivity of individuals to the reputation effect. If the shift is sufficiently great then the model would predict 100% membership, as in Figure 3a.

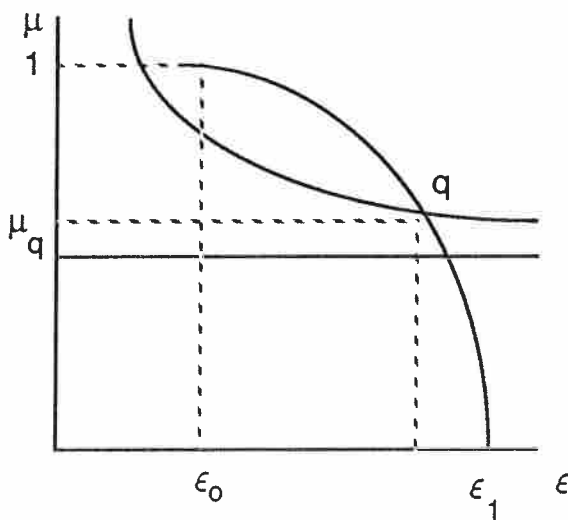


Fig. 3a. 100% density.

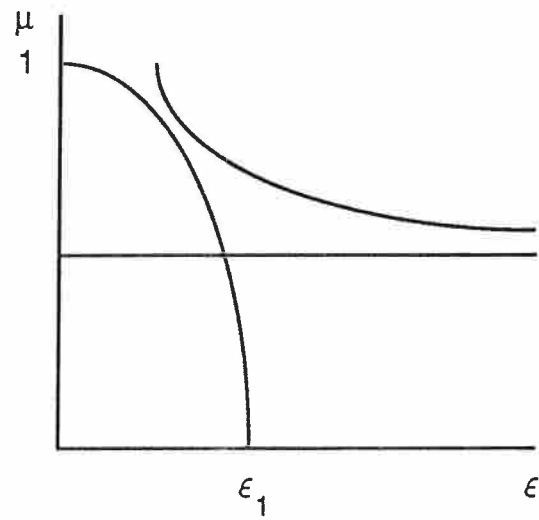


Fig. 3b. Zero density.

Conversely, a sufficiently large shift to the left, reflecting low importance of reputation effects, could produce an outcome such as that depicted in Figure 3b in which the only equilibrium is at zero membership.

Second, if the variance of the distribution diminishes, but with constant mean, the

position of the equilibria will also change. In the limit, as individuals become identical, the stable intermediate equilibrium vanishes and the only stable equilibria imply that everyone behaves identically - either everyone joins or no-one does. This is the special case of identical individuals discussed by Booth (1985) and can explain the existence of a union but does not provide an explanation of the intermediate density levels characterising the open shop trade union which is the focus of our analysis.

Third, the critical or threshold level of membership will fall and the stable equilibrium level of membership will rise if the decision schedule shifts to the left. Factors which will cause such a shift are a reduction in d , the union subscription cost, and an increase in w , the wage. Each of these changes generates a decline in the difference $U(w) - U(w - d)$ on the left of equation (1). More formally, it can be shown that the decision schedule shifts down as the wage increases as:

$$\mu_w = [U'(w) - U'(w - d)]/[V_\mu(\mu, \epsilon) + V_\mu(1 - \mu, \epsilon)] < 0$$

Fourth, it is clear from Figure 2 that the critical level of union membership exceeds 50% membership. This follows from the assumption that non-members derive utility from the reputation effects within the group of non-members, to the same extent that reputation effects accrue within the group of members. This is perhaps an extreme case. The moral sanction associated with breaking the social custom of not free-riding is likely to generate stronger reputation effects for union joiners and this would push down the asymptote on the membership decision schedule below the 50% mark. In the limit, it will fall to zero if there are no reputation effects within the group of non-members. We raise the possibility of some symmetry in reputation-derived utility for the purpose of generality. Even with no reputation effects amongst non-joiners, the zero asymptote on the decision schedule would produce some positive value for the threshold density level.

3. Stability.

In general, stability of the possible equilibria depends upon the relative positions of the distribution and decision schedules. For a given decision schedule, for example, the degree of worker homogeneity with respect to the reputation parameter will influence the stability properties of the equilibrium, as we have seen. There are other more general statements we can make about the stability of the model. First, in all possible⁷ cases there is a stable equilibrium associated with zero union membership. This means that for union organisation to get off the ground it might help to have an initial period in which there is either compulsion or an incentive private good. In the case shown on 3b this result is independent

⁷This assumes that the decision schedule cannot cut the horizontal axis [see Naylor (1990) on the implications of Kantian behaviour].

of the starting point for people's behaviour towards collective action. Second, in all cases other than that in Figure 3b, there are two qualitatively distinct stable outcomes. Either the population converges on non-membership or some part (≤ 1) of the population joins the union. In the case in which all join, depicted in Figure 3a, we have a model which explains the closed shop as the outcome of non-compulsory collective action. Third, the stable non-zero level of membership will vary with the shapes of the curves, but there is always a range of levels of membership, below some threshold, which cannot occur. In the formal model which we have derived this threshold occurs above 50% density, and while in general the magnitude of the threshold will depend on the strength of reputation effects associated with the social custom of membership, such a threshold will always be present.

We saw in the previous section a number of comparative static properties of the model. In particular, we concluded that the critical mass density level will rise, and the non-zero stable equilibrium will fall, as union dues rise or as the wage decreases or as reputation effects of membership become weaker. Starting from some initial positive stable equilibrium, these changes will occur in a relatively continuous manner. However, if, for example, the wage falls sufficiently then the level of unionisation will approach the threshold level and suddenly jump to zero. Given the values of the other parameters, then, there is some critical wage which will support a threshold level of membership. Wages above this level will take membership higher, but a wage below the critical level will see density drop to zero. This is shown in Figure 4.

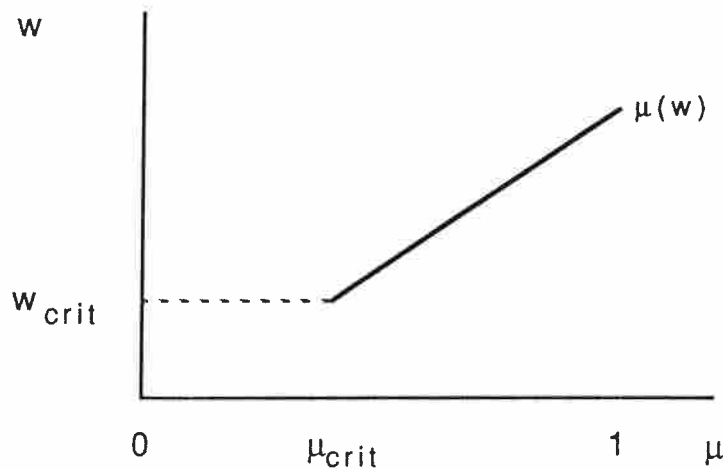


Fig. 4. Potential stable equilibrium union density varies with the wage above the critical level.

The reverse effect of jumping from a zero level of unionisation to some positive level is not so automatic. A rise in wages to w_{crit} , or above, might not restore union density to its

potential positive equilibrium value as zero membership is a stable equilibrium for all values of the wage. Thus, the existence of the threshold level of union membership [and the associated threshold wage level] generates a discontinuity in union density which has major implications. First, if the membership level in an establishment declines for exogenous reasons affecting the decision or distribution schedules, it will approach the threshold level and then suddenly drop to zero. Second, the reverse effect of jumping from a zero level of unionisation to some positive level need not occur. There might need to be an education or recruitment campaign by a union organisation in order to convince workers of the potential for union presence. In the aggregate, this suggests that union density might be "upwardly sticky" even where it is "downwardly flexible". This ratchet effect or asymmetric behaviour of union membership suggests a possible strategy for firms which wish to avoid or evade unionisation. A unionised firm which transferred production to a new establishment could hope to avoid unionisation *even if* the objective characteristics relevant to the union decision and distribution schedules were the same in each place. This possibility would be greater the higher the threshold level of union membership.

4. Empirical interpretation.

There are a number of puzzles concerning union membership behaviour, as Blanchflower, Crouchley, Estrin and Oswald (1989) have stated. First, there is the problem of explaining why, in the absence of compulsion, individuals join unions in the presence of the free-rider incentive. This is just one example of the prisoners' dilemma characteristics of the logic of collective action⁸. Second, there is the problem of explaining intermediate levels of membership in open shop trade unions. Third, there is the need to develop a theory which is capable of explaining the large and significant regional effects on membership, common to both individual worker level studies [see Booth (1986), Bain and Elias (1985) and Green (1990)] and cross-section studies at the level of the establishment [see Bain and Elsheikh (1980)], after controlling for other factors such as industry and establishment size. Our model is intended to offer an explanation of the first and second of these puzzles. Before we address the model to the issue of the third, we consider an alternative explanation of the determinants of union membership which attempts to cast light on these questions.

Blanchflower, Crouchley, Estrin and Oswald (1989) argue that an individual who joins a union incurs the certain cost of membership dues but enjoys the uncertain benefit which comes from membership of the union reducing the risk to the individual of being dismissed unfairly. Individuals are assumed to be heterogeneous with respect to their attitudes to risk - the more risk-averse workers join the union and the less risk averse do not. Union density in a plant will be at a level determined by the attitude to risk of the marginal member. A

⁸See Schelling (1978) and Hardin (1982)

corollary is that union membership will be higher in establishments with higher levels of unemployment in the local labour market as this will increase the benefits of being insured against dismissal. It is then argued that it is the regional pattern of unemployment which explains the otherwise puzzling regional effect on union membership.

Like our model, but unlike that of Grossman, the Blanchflower *et al.* approach views the union membership decision as secondary to - and distinct from - the job choice decision. However, we see a number of problems with their approach. First, aggregate data show that union membership displays a clear procyclical pattern, falling as unemployment rises. Yet the model of Blanchflower *et al.* would predict a counter-cyclical relationship as workers would value membership more when unemployment is high. Second, cross-section data from the two WIRS surveys in the UK demonstrate that between 1980 and 1984 union density within establishments did not change, despite significantly higher unemployment rates in the latter period. This is not consistent with the Blanchflower *et al.* theory according to which density should have increased between the two periods. It is consistent with the social custom approach which would emphasise the underlying and less mutable properties of traditions and norms, which are unlikely to be strongly cyclical. Third, it is not clear that union members are likely to be more risk-averse than non-members. Union members occasionally face problems of victimisation and blacklisting. Similarly, it is the members of unions who reveal relatively low levels of risk-aversion when they demonstrate a preparedness to engage in industrial action in support of a pay claim.

Furthermore, a common finding in econometric studies of union membership using individual worker level data is that the individual's personal characteristics are surprisingly insignificant determinants of union status [see Bain and Elias (1985) and Booth (1986)]. We would argue that this is consistent with the theory that it is the social customs and other workplace characteristics which shape the individual's union membership decision. Further support for this idea comes from Green (1990) who finds that region is an important determinant of union presence because it, "...is the region of work which reflects the histories and the politico-economic cultures of each part of the country." To the extent that such cultural traditions or social custom effects are correlated with the regional pattern of unemployment, this would also explain the significance of local unemployment rates in regression analysis of union membership.

5. Extensions

5. 1. *Wage outcomes*

We showed in Section 3 how union membership in the establishment is likely to vary with the wage. In this sub-section we examine what happens to wages and union membership when we allow for the possibility that the wage depends simultaneously on the level of unionisation in the establishment.

There is a class of theoretical models which attempt to model union membership and wage determination endogenously, but these tend to assume a closed shop trade union. A common assumption is that membership equals employment⁹. Thus, whilst there is, in these models, a rigorous microeconomic explanation of the wage choice by the union, usually generated in a median voter model of union behaviour, the explanation of union membership is more *ad hoc*.

In order to generate a relationship for wages as a function of membership, there are two main alternative approaches we might take. First, we could develop a median voter model relating how the union's preferred wage varies with membership. This would be consistent with Grossman (1983). However, whilst in a closed shop context it is perhaps reasonable to adopt the monopoly union assumption that the wage outcome is determined solely by union preferences, in our more general context of the open shop trade union it is more appropriate to adopt a more general right-to-manage approach in which the union and the firm bargain over the wage. In this approach the wage outcome would be dependent on the relative bargaining strengths of the two parties. We adopt this alternative approach and assume that union bargaining power is a function of the level of union membership density in the establishment. We do not offer a rigorous micro-foundation for this assumption. Raaum (1989) has developed a model in which union density in the establishment determines the disagreement payoff to the firm in the event of a conflict and, hence, shows that the Nash-bargained wage outcome¹⁰ is increasing in union membership. We shall assume explicitly that the bargained wage in the establishment depends on union membership in this way, but shall not impose stronger assumptions on the nature of the dependency. Instead, we compare the stability and comparative static properties of different functional relationships between wages and union density.

Suppose, initially, that the bargained wage outcome depends on union density as depicted in Figure 5a. This suggests a diminishing marginal effect of membership on the

⁹Burda (1990) considers the more general alternative that membership is a Koyck distributed lag of current and past employment.

¹⁰The wage outcome will, in general, affect the firm's employment decision. We assume that the ϵ -distribution schedule, and therefore the union membership schedule, are independent of the absolute level of employment.

wage. Empirically, this case is likely to describe production processes in which labour inputs are complementary and hence in which a stoppage by some proportion of workers has a sizeable impact on the total output of the firm. In Figure 6 we bring together the wage schedule of Figure 5a and the membership schedule of Figure 4. Let w_N denote the wage outcome if the union has no influence on the wage. We know from Section 2 that one stable equilibrium occurs at $\mu = 0, w = w_N$. A second stable equilibrium occurs at point a in Figure 6. At this point, $\mu = \mu_U$ and $w = w_U$. An increase in union power which causes an upward shift in the wage function will raise both wages and membership, eventually to a corner solution with $\mu = 1$. Conversely, a downward shift in the wage schedule will produce lower equilibrium levels of both membership and the wage. Below w_{crit} membership jumps to zero and the wage to w_N from which level, because $\mu = 0$ is a stable equilibrium, it might not rise even if the wage schedule returns to its original position.

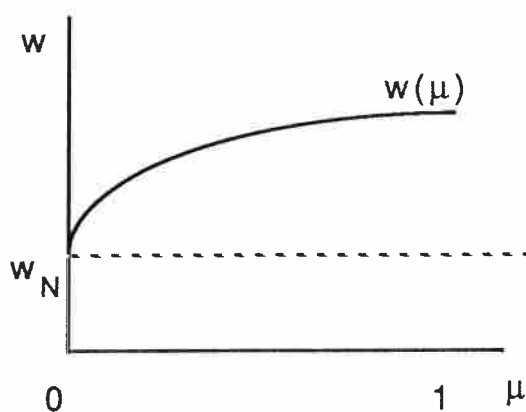


Fig. 5a. Concavity of $w(\mu)$.

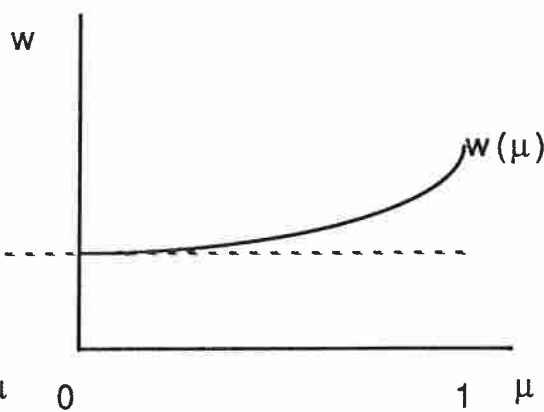


Fig. 5b. Convexity of $w(\mu)$.

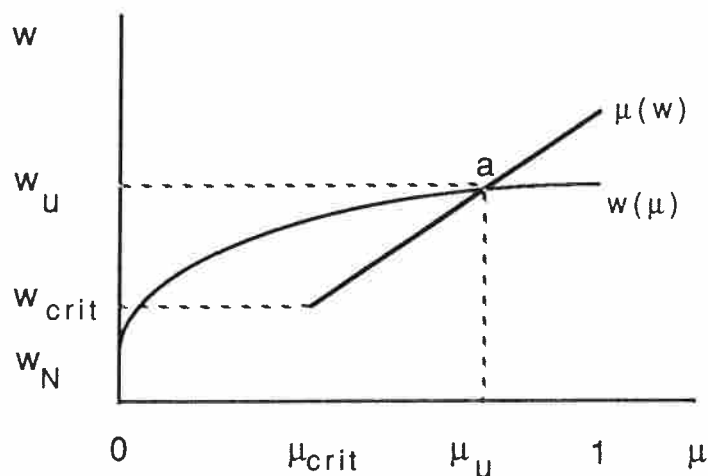


Fig. 6. Simultaneity of wages and membership.

We now consider how the properties of the model vary, if at all, under conditions characterised by the wage schedule depicted in Figure 5b. We show this case in Figure 7. Point b in Figure 7 represents an unstable equilibrium outcome because the wage schedule cuts the membership schedule from below at point b. This adds an extra dimension to the critical mass level of membership which the union must achieve for union density to become self-sustaining. It is no longer sufficient for the union to achieve μ_{crit} , it must recruit at least μ_b members to set in motion a dynamic process leading to a stable equilibrium union membership at $\mu = 1$, $w = w_u$.

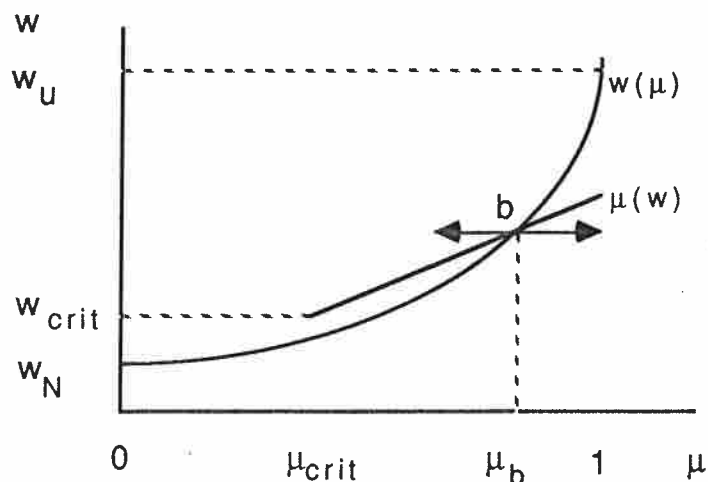


Fig. 7. Simultaneity with a convex wage schedule.

This, then is an alternative explanation of the union closed shop outcome - the institutional result of the simultaneous determination of wages and union density producing 100% membership. It is the consequence of the increasing marginal returns to union membership implied by the convexity of the wage schedule and suggests the sensitivity of wage and membership outcomes to the nature of the firm's production technology and the associated distribution of bargaining power between the firm and the union. This conclusion can be drawn only by deriving the wage schedule from the impact of membership on bargaining power. Models which focus instead on the relationship between membership and union wage preferences [see Grossman (1983)] tend to derive downward-sloping wage schedules which would generate properties qualitatively similar only to those cases depicted in Figure 6.

The comparative static, as well as the stability properties of the model, are different in the two cases. In Figure 7 there cannot be intermediate stable equilibrium levels of membership. Changes in the parameters of the two schedules have either no effect on union membership or they cause switching between the two corner solutions - with a bias toward

$\mu = 0$ because of the discontinuity below μ_{crit} . A shift in the membership schedule for all $\mu_{crit} < \mu_b < 1$ has no effect on either the wage nor the density stable equilibrium outcomes. Conversely, in Figure 6, changes in the membership schedule are likely to affect both wage and membership outcomes. In principle, these predictions are testable against micro panel data sets at the level of individual establishments.

5. 2. *Non-concavities in the Distribution Schedule.*

In the previous Section we assumed that the distribution schedule could be represented by a concave curve, as in Figure 2. When combined with a convex decision schedule this gives three possible equilibria, two of which are stable (one at zero membership) and one of which is unstable. In general, however, the distribution function can switch between ranges of concavity and convexity, thereby producing a greater multiplicity of possible equilibria. We would therefore expect to find more than one non-zero stable equilibrium level of union membership. This implies that the $\mu(w)$ schedule shown in Figure 4 is in fact a correspondence and is not necessarily a function. If, in the presence of multiplicities, we define $\mu(w)$ to be the smallest possible stable level of intermediate union membership, it may have discontinuities, i.e. upward jumps. This is shown in Figure 8. This possible extension to the model does not invalidate our previous analysis, but adds to the possibility of multiplicity of equilibria.

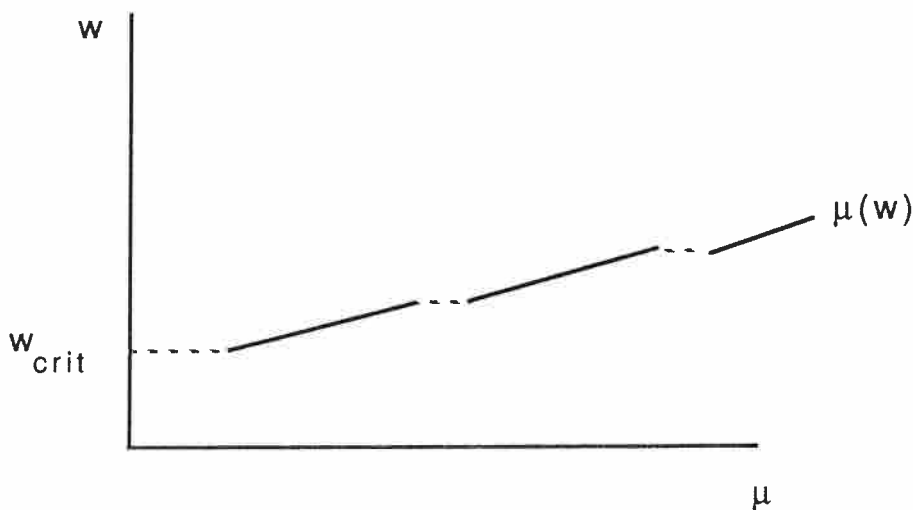


Figure 8. Discontinuities in the membership schedule.

We can verify that the $\mu(w)$ schedule is upward sloping by calculating its derivative

$$\frac{\partial \mu}{\partial w} = \frac{U'(w) - U'(w-d)}{V_{\mu}(\mu, \epsilon) + V_{\mu}(1-\mu, \epsilon) - f(\epsilon[V_{\mu}(\mu, \epsilon) + V_{\mu}(1-\mu, \epsilon)])}$$

The sign of the denominator appears to be ambiguous, but as this is calculated at a downward intersection of the decision and distribution schedules it must be negative because the slope of the distribution schedule $-f(\epsilon)$ is relatively large.

5. 3. Commitment effects.

We return to the basic model of Section 2. In the context of wage norms, Akerlof (1980) suggests that in addition to utility deriving from reputation effects there is a disutility incurred by breaking the social custom. We allow for this possibility by amending equation (1) so that:

$$U_i = U(y) + V(\mu, \epsilon_i) - \pi(1 - \mu, \lambda_i) \quad (2)$$

where $\pi(1 - \mu, \lambda_i)$ is the utility loss of breaking the social custom believed by μ of the population, for an individual with characteristic λ_i . This change allows us to measure the regret felt by people in not abiding by the social custom. Then the condition for individual i to join becomes:

$$\pi(1 - \mu, \lambda_i) - \pi(\mu, \lambda_i) + (U(w) - U(w - d)) \leq V(\mu, \epsilon_i) - V(1 - \mu, \epsilon_i) \quad (3)$$

How does the introduction of this disutility term affect the decision schedule? We will assume in what follows that $\pi_1 \geq 0$, $\pi_2 \geq 0$ and $\pi_{12} \geq 0$. Hence, the disutility of not abiding by a social custom has similar properties to the function $V(\cdot)$.¹¹ We can thus deduce that the left side of (3) is decreasing in μ and decreasing in λ_i , provided that $1 - \mu > \mu$. One can then see that such an extension preserves a downward-sloping decision schedule in μ and ϵ_i for a fixed λ_i , which lies everywhere above the unamended schedule, yet continues to be asymptotic at $\mu = 0.5$. Increases in the value λ_i will tend to decrease the LHS of (3) and hence tend to shift the decision schedule inwards.

Now suppose that the individual's characteristics are distributed according to some continuous density $f(\lambda_i, \epsilon_i)$ defined on some convex support. Then an individual joins the union if his or her characteristics satisfy inequality (3) given prevailing beliefs. So, provided we assume that those with high values for ϵ_i and low values for λ_i join the union we can analyse this model in essentially the same manner. The qualitative nature of the conclusions derived from such an analysis differs very little from that already obtained. The only significant addition is the possibility of analysing the different effects of increasing and of decreasing correlation of characteristics.

¹¹Hence, we could re-interpret the whole model in terms not of heterogeneous sensitivities to reputation effects but of heterogeneity with respect to individual commitment to the social custom itself.

6. Conclusions

We have developed a model which is capable of explaining a number of apparently puzzling features about union membership. First, we have overcome the 'free-rider' problem in providing an explanation of voluntary membership of the open shop trade union. Second, the model is capable of explaining intermediate equilibrium levels of membership. Third, the model is consistent with the empirical findings that regional effects are important but that personal characteristics are insignificant determinants of union membership.

The model carries the implication that union membership in the establishment, and therefore probably in the aggregate too, is likely to respond asymmetrically to exogenous shocks. If the wage schedule, for example, is pushed downward [because of, say, a reduction in union bargaining power] below some critical level, then membership will drop to zero. A return of the [potential] wage schedule to its original level need not regenerate union membership as zero density is always a stable equilibrium. Central union activity might be necessary to re-establish at least the critical mass level of membership. For a given membership schedule, this will be more difficult if there are increasing marginal returns to union membership, which we associate with worker-complementarity in production, as this causes a higher critical mass or threshold level for union density.

We have hypothesised a wage schedule which relates union negotiated wages to union membership on the assumption that wages are dependent on bargaining power which is in turn a function of membership. We have considered how different production technologies are likely to generate different forms of this functional relationship and how these are likely to have different stability and comparative static properties. An alternative method would have involved mapping the relationship between union membership and the union's preferred wage and then to have assumed this to be the wage outcome. But we believe this to be less valid than in the case of the union closed shop. In the context of the open shop union it is far from clear that a small union membership with a high wage preference would have much chance imposing this wage on the firm. Hence, our concern with the development of a model which attempts to explain membership in the open shop trade union.

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