DIVISION OF THE HUMANITIES AND SOCIAL SCIENCES

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THE ANALYSIS OF COMMITTEE POWER: AN APPLICATION TO SENATE VOTING ON THE MINIMUM WAGE

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SOCIAL SCIENCE WORKING PAPER 641

April 1987

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A widely noted empirical regularity of congressional behavior is that standing committees exert disproportionate influence on congressional choices. The observed phenomenon has a number of labels—committee influence, committee power, and (from the parent chamber's perspective) deference to committees—and a large body of theoretical and empirical research has sought to determine when and why it exists. This paper takes as given only the weakest form the observation, namely, that *committee power exists sometimes.* It does not directly address the questions of when and why committee power exists, although much of the relevant literature is reviewed. Rather, it focuses on a prerequisite to the resolution of disputes about committee power. How can committee power be assessed empirically? Section I reviews three classes of explanations and identifies obstacles to convincing empirical tests of the accounts. Section II introduces an econometric approach for analyzing committee power. Section III applies the technique to a sequence of votes on minimum wage legislation in the Senate in 1977. Section IV extends the technique to multi-dimensional choice spaces. Section V is a discussion and summary.

I. Explanations and Problems of Inference

The quantity of literature on committee power is a testimony to its central place in the study of legislatures. Our objective is not to review the literature exhaustively[1] but rather to classify explanations for committee power and to highlight a common obstacle to evaluating these explanations empirically. The three classes are behavioral, institutional and informational.

Behavioral explanations for committee power are grounded in sociological literature and focus on a system of norms or *informal* rules of the game such as reciprocity and deference (Matthews, 1960). The parent chamber is said to defer to committees because the parent

[1] Interested readers should see Eulau and McCluggage (1984).

chamber consists of members who are on other committees and who presumably will benefit in-kind from future acts of deference. These reciprocity arrangements may take several forms. At the individual level, members simply trade votes (Tullock, 1970). At the committee level, cross-jurisdictional logrolling may occur (Ferejohn, 1985). Members self-select onto committees whose jurisdictions contain policies that are of special interest to their constituents (Shepsle, 1978). Committees' proposals are then typically well-received on the floor with the implicit understanding that today's recipients of deference (the committee members) will at some future date act reciprocally as grantors of deference (as members of the parent chamber) to other committees' legislation. Many congressional policies are characterized as conferring concentrated benefits to constituents while dispersing costs (Wilson, 1973, pp. 333–4), and this feature, combined with the ability of congressmen similarly to claim credit and disperse blame helps sustain logrolling agreements. Indeed, the committee system itself may also facilitate credible credit-claiming by giving members opportunities to engage in oversight activities that are likely to be observed by constituents (Mayhew, 1974, p. 92). Whatever the basis for deferential behavior, reciprocity, and logrolling,[2] their end result is the same: adoption of policies that disproportionately reflect committee members' preferences *vis-à-vis* those of the parent chamber. Thus, norms or informal rules of the game may enhance committee power.

A contrasting but not necessarily incompatible explanation for committee power is institutional and focuses on how *formal* rules and precedents confer disproportionate benefits to committees. The more recent of this literature employs formal models to illustrate or to specify general conditions under which committees acquire favored outcomes. For example, committees may benefit as initial proposers of legislation if they can initiate or obstruct legislation (Romer and Rosenthal, 1978; Denzau and Mackay, 1983; and Krehbiel, 1985).[3] Broad jurisdictions and complex special orders may create opportunities for strategic "bundling" of legislation and corresponding disproportionate benefits (Gilligan

[2] Under specifiable formal assumptions the political benefits from reciprocity arrangements may exceed their political costs. Thus, the traditional sociological focus on norms as keys to understanding congressional behavior is not necessarily inconsistent with more recent, economically-oriented studies. Hence, for example, the "rational choice perspective for congressional norms"(Weingast, 1979; See also Fiorina, 1981).

[3] Note, however, that procedures such as the discharge petition in the House and discharge precedents in the Senate cast doubt on the descriptive accuracy of these powers with respect to Congress.

and Krehbiel, 1986). And committees may possess power as negotiators (or, perhaps more accurately, as bicameral co-conspiritors) in conference committees if they possess an "ex post veto" (Shepsle and Weingast, 1987).

Finally, committee power may be attributable to the informational advantage that committee members possess for policies within their jurisdictions. With few exceptions, comparative and case studies of congressional committees stress the role of committees as repositories of policy expertise (MacNeil, 1963; Fenno, 1973). Several accounts also stress the incentives for individual committee members to acquire expertise (Matthews, 1960; Huitt and Peabody, 1969; Fenno, 1966) and the disproportionate committee power that can arise (MacNeil, 1963; Manley, 1970; Fenno 1973). Indeed, historical studies of Congress argue persuasively that one key rationale for the standing committee system was for committees to specialize in the acquisition of information to serve the parent chamber (Cooper, 1970).[4]

How can the behavioral, institutional and informational accounts of committee power be assessed, compared, or refuted? In light of the difficulty of these tasks, the diversity of existing empirical efforts to assess committee power is not surprising.[5] Nor is the persistence of controversies over the sources of committee power. Obviously, empirical assessment of committee power is severely constrained by what is observable. Less obvious, however, are several pervasive problems of inference that confuse the meanings of that which is readily observable. Consider two sets of examples, corresponding to the behavioral and institutional explanations, respectively.

First, observation of hostile or deferential behavior in the form of amendment activity may offer insights regarding committee power. For example, small or large numbers of

[4] Of course, the informational advantage may be a mixed blessing for the parent chamber insofar as expertise also gives rise to the possibility of strategic use of private information by the committee. The prospects for strategic use of information are widely accepted in economics, but the associated theory is just beginning to be used to study legislative politics. See, for example, Austen-Smith and Riker (1987) for a voting game with private information, and Gilligan and Krehbiel (1987) for a committee-parent chamber game with asymmetric information and endogenous choice of procedures.

[5] These include case studies and comparative studies using interview techniques (e.g., Fenno, 1966, 1973), studies based on analysis of congressional data (e.g., Bach, 1985; Dyson and Soule, 1970; Smith, 1986), one study based on analysis of stock market data (Gilligan and Krehbiel, 1986) and several books containing a variety of techniques (e.g., Fenno, 1966; Smith and Deering, 1984).

amendments offered to a committee's bills may indicate deference toward the committee or power of the committee, respectively. In the extreme, committee power may manifest itself in the form of refusal on the part of parent chamber to amend the committee's bills. Yet, as the following possibilities illustrate, inferences from such data regarding committee power are hazardous. First, committee and parent chamber preferences may not diverge, in which case the issue of committee power *vis-à-vis* the parent chamber is moot. Second, preferences may diverge but committees may be weak. Nevertheless, if committee members anticipate being "rolled" on the floor, they may report face-saving bills that correspond more closely to parent chamber preferences than to those of the committee. Conversely, a strong committee might be more willing to confront amendments. Dyson and Soule (1970) try to avoid this problem by counting only amendments that pass over the opposition of a majority of committee members, but this does not escape another problem. Amendments may be either major or minor, or either close to or far from the committee median. A committee that wins on major provisions may lose on minor ones. Furthermore, were it possible, weighting amendments by their importance would not work either, because the real question is whether the committee ultimately obtained an outcome closer to its ideal position than that of the parent chamber.[6]

Second, committee power might be assessed by observing (or not observing) various formal procedural challenges to the committee. Use of the discharge procedure in the House, for example, might be taken as evidence that the discharged committee is weak. Or, refusal to use discharge procedures may be interpreted as evidence that the committee is free to exploit the parent chamber by reporting bills closer to committee members' positions. However, the same objections can be lodged against these inferences as were directed towards inferences from amendment behavior on the floor. If a committee anticipates a discharge petition, then it may concede points in advance to avoid embarrassment from the procedural roll. In these cases, the inference of committee power would be wrong.[7]

[6] Technically, in a unidimensional setting, the spatial issue concerns *median voters* in the committee and on the parent chamber. For simplicity we adopt the convention of referring to committees and the parent chamber as unitary actors but acknowledge the associated theoretical difficulties.

[7] Analogous inferences based on the use of other procedures are also inappropriate. Examples include the acceptance or rejection of restrictive rules (which typically benefit committees), consent or objection to unanimous consent agreements (the latter of which can sometimes kill a bill and therefore can be used as a credible threat), or use versus cir-

More generally, although these two classes of inference differ in terms of what is (or is not) observed, the crucial missing link is the same: information on actors' preferences. Without such information inferences about committee power from readily available data are fraught with ambiguity. Our point is not that all such inferences about committee power are necessarily wrong, but only that they can be, as in the case of Senate minimum wage amendments in 1977 (discussed in Section III). There the committee prevailed when two amendments to the bill it reported were easily defeated. Traditional approaches would count these votes as evidence of committee power. Yet when the final outcome is compared to the preferences of different actors, there is no evidence of committee influence: the committee proposal was indistinguishable from the chamber median and much lower than what a majority of committee members would have preferred. The next section describes a technique for estimating preferences that permits stronger inferences about the nature and degree of committee power.

II. Estimation of Preferences

If committee power can be assessed only by comparing legislative outcomes with legislative preferences, then statistical methods are required to estimate the preferences of legislators. The methods described below are, with appropriate adaptation, applicable to a broad range of legislative votes. To keep matters simple, we focus on a single undimensional issue which, for the sake of concreteness and subsequent application, we refer to as the minimum wage level. The minimum wage example is convenient since minimum wages have an obvious and natural metric (dollars) and the location of various bills in the policy space is known. In Section IV, however, we show that the technique extends to situations where the dimension of choice has no natural metric and the location of bills must be estimated.

In the case of minimum wage legislation, precise estimation of preferences is possible without imposing any severe assumptions. This section describes our assumptions about the behavior of legislators and explains how roll call votes can be used to estimate preferences. We assume that a legislator's preferences over minimum wage levels can be represented by

cumvention of restrictive and pro-committee procedures during the resolution of bicameral differences (such as appointment of conferees from the committee with original jurisdiction, refusal to instruct conferees, and consideration of the conference report under a strict up-or-down vote).

a symmetric single-peaked utility function $u_i(\theta)$ where θ denotes the level of the minimum wage and i indexes the legislator ($i = 1, \ldots, n$). We will also assume that u_i attains a unique maximum at some point x_i which will be referred to as the legislator's ideal point or bliss point.[8] Under these assumptions, u_i can be written in the form:

$$u_i(\theta) = \phi_i(|\theta - x_i|) \tag{1}$$

where ϕ_i is any monotone decreasing function.

Next, the legislator's ideal point is related to characteristics of his or her constituency. Characteristics of the legislator's constituency that might influence the legislator's preferences over minimum wage levels include the average wage level or the proportion of workers belonging to labor unions in the constituency. Characteristics of the legislator, such as his or her party affiliation or the ratio of union to corporate contributions in his or her party affiliation or the ratio of union to corporate contributions in his or her last campaigns might also affect minimum wage preferences. These variables are discussed in greater detail in the following section, but for now it suffices to identify a vector z_i of factors thought to influence the legislator's most preferred minimum wage level x_i.

If legislators' preferences, x_i, were observable, then the natural procedure would be to regress x_i on z_i. The task here, of course, is to determine x_i since we have no direct measure of legislators' preferences about minimum wages. Nonetheless, following the regression analogy, we posit a linear relationship between a legislator's ideal point and his or her characteristics:

$$x_i = z_i'\gamma + \epsilon_i \qquad (i = 1, \ldots, n) \tag{2}$$

where the error term ϵ_i is included to capture the effects of all other factors influencing the legislator's preferences. As is standard in the literature, we assume that ϵ is normally distributed with mean zero and variance σ^2 independent of z_i. Some recent results suggest that the estimator used is somewhat robust to violations of the normality assumption (Ruud, 1983).[9]

[8] The assumptions here are somewhat weaker than the quadratic utility assumption used by Krehbiel and Rivers, 1985, or Poole and Rosenthal, 1985.

[9] Alternatively, the normality assumption can be dropped altogether and semiparametric estimation techniques (such as that suggested by Ichimura, 1986) used in place of probit analysis. Although, this would require only minor changes of detail in what follows, this approach would only allow estimation of γ up to scale.

Since direct measures of x_i are unavailable, we rely on the revealed preferences of legislators in roll call votes to estimate x_i. The primary assumption necessary for the analysis is that legislators vote sincerely, i.e. if a legislator votes for one alternative over another, he or she actually prefers that alternative. Of course situations may arise in which it is in the interest of a legislator to vote "strategically" by, for example, voting for a "killer" amendment not because he likes it but rather because it guarantees failure of the unfavored bill to which the amendment is offered.[10] However, for reasons explained below, opportunities for sophisticated voting were limited in the case we analyze. Elsewhere (Krehbiel and Rivers, 1985) we explicitly test for the possibility of strategic voting on the minimum wage votes and reject the hypothesis of sophisticated voting.

We consider the situation where two votes are taken. First, legislators vote between minimum wage levels θ_1 and θ_2, and θ_2 is victorious. Second, θ_2 is voted against θ_3. The values of θ_1, θ_2 and θ_3 can be determined from the record. In our case, $\theta_1 < \theta_2 < \theta_3$. (In other situations these values could be estimated, but this will not be a concern here.) Under assumption of sincere voting, a legislator votes for alternative θ_1 over θ_2 in the first vote if $u_i(\theta_1) > u_i(\theta_2)$ and otherwise votes against θ_1. In the second vote, legislator i votes for θ_2 over θ_3 if $u_i(\theta_2) > u_i(\theta_3)$, and otherwise votes against θ_2 in the second vote. In the two votes there are four possible voting patterns which "reveal" the legislator's preferences as shown in the top of Table 1. From the assumptions about utility functions in equation (1), $u_i(\theta_j) > u_i(\theta_k)$ if and only if $\phi_i(|\theta_j - x_i|) > \phi_i(|\theta_k - x_i|)$. Since ϕ_i is strictly decreasing, this condition is equivalent to $|\theta_j - x_i| < |\theta_k - x_i|$ which, in turn, is equivalent to $x_i < (\theta_j + \theta_k)/2$ if $\theta_j \leq \theta_k$ or $x_i > (\theta_j + \theta_k)/2$ if $\theta_j > \theta_k$. Thus we have the bottom of Table 1 which defines the intervals depicted in Figure 1.[11]

[Table 1 and Figure 1 here]

The method for estimation of ideal points relies on revealed preferences. As Table 1 and Figure 1 show, the voting pattern of each legislator implies that his or her ideal point

[10] See, for example, Farquharson (1969), Enelow (1981), Enelow and Koehler (1980), and Denzau, Riker and Shepsle (1985).

[11] Since we have assumed that $\theta_1 < \theta_2 < \theta_3$, is not possible for $x_i < (\theta_1 + \theta_2)/2$ and $x_i \geq (\theta_2 + \theta_3)/2$ to hold simultaneously. That is, we should not observe any (Yes, No) votes. The upper right hand cell of Table 1b should be empty (as it is for the pair of minimum wage votes analyzed in the next section). With other orderings of the bill locations, other cells should be empty, but unidimensionality always implies the existence of at least one empty cell. This suggests a simple nonparametric test for unidimensionality of roll calls.

TABLE 1

Deriving Revealed Preferences from Votes

θ_1 vs. θ_2

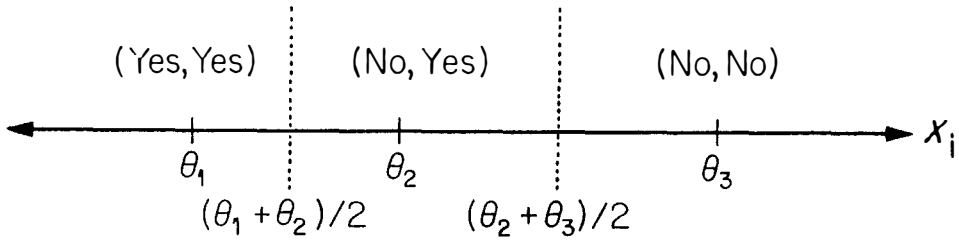
θ_2 vs. θ_3	No	Yes
No	$u_i(\theta_1) \leq u_i(\theta_2)$ $u_i(\theta_2) \leq u_i(\theta_3)$	$u_i(\theta_1) > u_i(\theta_2)$ $u_i(\theta_2) \leq u_i(\theta_3)$
Yes	$u_i(\theta_1) \leq u_i(\theta_2)$ $u_i(\theta_2) > u_i(\theta_3)$	$u_i(\theta_1) > u_i(\theta_2)$ $u_i(\theta_2) > u_i(\theta_3)$

θ_1 vs. θ_2

θ_2 vs. θ_3	No	Yes
No	$x_i \geq (\theta_1 + \theta_2)/2$ $x_i \geq (\theta_2 + \theta_3)/2$	$x_i < (\theta_1 + \theta_2)/2$ $x_i \geq (\theta_2 + \theta_3)/2$
Yes	$x_i \geq (\theta_1 + \theta_2)/2$ $x_i < (\theta_2 + \theta_3)/2$	$x_i < (\theta_1 + \theta_2)/2$ $x_i < (\theta_2 + \theta_3)/2$

Figure 1

Ideal Points Revealed by Voting Patterns



x_i falls into a particular interval. Although this information is not sufficient to identify the precise value of x_i, there is enough information to estimate the relationship between the ideal point x_i and the legislator's observable characteristics z_i. The basic idea is that equation (2) is in the form of an ordered probit model. Low values of x_i would imply that the legislator would vote "Yes" on both roll calls, while high values would imply "No" votes in both cases. Intermediate values of x_i would imply support for the higher minimum wage θ_2 proposed in the second amendment and opposition to the lower level θ_1 proposed in the first amendment. Thus, voting patterns provide a rough categorization of ideal points x_i as "low," ((Yes,Yes) in Figure 1), "medium," (No,Yes), or "high" (No,No) and equation (2) falls within the ordered probit framework considered by Aitchison and Silvey (1957).

What distinguishes the present situation from the usual probit case is that if the bill locations (θ_j) are known (as in the minimum wage example) the parameters γ can be estimated consistently. If the bill positions are unknown, then we are back in the customary position of only being able to estimate γ only up to a multiplicative scale factor. (Details are provided in an appendix.) In both cases the relationship between ideal points and the observable characteristics of legislators can be analyzed. When bill positions are known, we can estimate the actual distance (in terms of dollars for minimum wages) between, say, Democratic and Republican legislators, while in the other case it will only be possible to say whether Democrats have higher or lower ideal points (on average) than Republicans. The bill positions provide the metric for the estimated ideal points.

III. Application to the Minimum Wage Amendments of 1977

To assess committee power in an actual congressional setting, we apply the technique introduced above to roll call votes taken during the Senate's consideration of minimum wage legislation in 1977. This analysis culminates in estimation and comparison of median ideal points of members of the full Senate and of its Committee on Labor and Human Resources. The dimension on which ideal points are scaled is simply the hourly wage in dollars. The analysis proceeds several steps: discussion of the congressional history of the minimum wage issue, estimation of the determinants of voting on the minimum wage, derivation of Senator's ideal points, and finally, interpretation in the context of committee power.

Congress first adopted a minimum wage of twenty-five cents per hour in the Fair Labor

Standards Act of 1938 and has periodically raised the mandated level as wage inflation has rendered the old minimum wage ineffective. Such was the case in 1977 when a newly elected Democratic president, prodded by his union supporters, proposed a twenty cent per hour increase from the existing $2.30 per hour minimum to $2.50 per hour. The increase proposed by President Carter fell far short of labor's expectations. Unions desired an immediate increase in the minimum wage to $3.00 per hour with additional increases in subsequent years. After protracted negotiations with union leaders and their allies in civil rights groups, the Carter administration revised its proposal to incorporate a $2.65 minimum (effective January 1978) that would be indexed to the inflation rate. In response to heavy industry lobbying in September, the House rejected indexing and substituted a schedule of increases: $2.65 in 1978, $2.85 in 1979, and $3.05 in 1980. In October the Senate, after considerable squabbling (discussed below), approved a four-step increase in the minimum wage: $2.65 in 1978, $2.90 in 1979, $3.15 in 1980, and $3.40 in 1981. In conference, a compromise reduced the 1980 minimum to $3.10 and the 1981 minimum to $3.35 (where it remains as of this writing). Both chambers approved the conference report and the bill was enacted into law.

The minimum wage amendments of 1977 are amenable to the analytic techniques sketched above and permit some inferences about committee power that, in the absence of such techniques, are not possible. The Senate minimum wage votes involved a single, clearly defined dimension of choice: at what level should the minimum wage be set? Estimates of preferences on this dimension are easily interpreted as dollar amounts. Although, as will be shown, there was little possibility for strategic voting on the 1977 minimum wage amendments, we are able to establish with some confidence what strategies were available and what the likely outcomes would have been if different strategies had been adopted by the participants.

Senate debate on the minimum wage bill broke no new ground. Proponents argued that an increase was long overdue (it had been three years since the minimum wage had been raised with considerable inflation in the intervening period). At $2.30 per hour, the minimum wage would provide an annual income of only $4,800 which would leave a family of four under the poverty level. By gradually raising the minimum wage, they reasoned, no fully employed worker would earn less than the poverty level. Opponents countered that raising the minimum wage does not necessarily raise anyone's wage and that the more likely

consequence would be to *reduce* employment since employers would have incentives to lay off current workers whose productivity could not justify a wage in excess of the new mandated minimum. An increased minimum wage would also, they argued, harm the employment prospects of those currently out of work (especially teenagers with little or no labor market experience). As in other years, conservatives tried proposing a lower minimum wage for teenagers when it became apparent that their general arguments about the ill effects of the minimum wage would not prevail.

The confusing part of this argument is not its content, but rather who made it. Conservatives are not known for their overwhelming concern about unemployment. Nevertheless, they based their arguments almost exclusively on the bill's adverse effects of low wage workers and the unemployed. In the case of employment effects, conservatives clearly had the better of the argument. In a competitive labor market, where workers are paid their marginal revenue product, raising the minimum wage will cause employers to layoff their lowest paid workers. However, under monopsony (e.g., when workers accumulate firm-specific human capital that is not transferable to another employer) some workers may be paid less than their marginal revenue product and will manage to hold on to their jobs even when the minimum wage is raised above their previous wage. Liberals sometimes argue that employment losses from increasing the minimum wage will be small and offset by wage gains.[12]

Conservative concern over unemployment and a liberal preference for increasing the earnings of some workers at the cost of more unemployment for their less well paid colleagues appear implausible. A more likely explanation for the political alignment on the minimum wage issue is constituency based. The primary advocates of increasing the minimum wage are labor unions whose preferences on this issue have a clear economic foundation. Had labor's proposed increase in 1977 been enacted, it probably would have substantially restricted the ability of firms to substitute low wage nonunion workers for their typically better paid union counterparts. (Small to moderate increases, such as that finally adopted in 1977, appear to have minimal employment effects. Some low wage workers may increase their earnings, but wage inflation means that the real minimum wage stays constant or

[12] For a survey of economic opinion on the effects of minimum wages, see Brown, Gilroy, and Kohler (1982), pp. 487–528.

even falls so that the constraint turns out to be nonbinding for most workers soon after its adoption.) The beneficiaries of raising the minimum wage are workers earning somewhat more, but not substantially more, than the minimum, since their services are more easily substitutable for those of low wage workers. These are precisely the workers most likely to be unionized.

Minimum wage increases are often supported by northern Republicans, perhaps because the degree of unionization in their states forces them to compete for union votes. Apart from unionization, northern states also tend to have higher wage levels than southern or western states. Raising the minimum wage only raises wage rates in areas where the prevailing wage is near the minimum. By narrowing the gap in labor costs between northern and southern manufacturers, minimum wage increases can benefit northern states without having any direct effect upon their internal labor markets.

This brief discussion has identified several factors that might lead legislators to favor or oppose an increase in the minimum wage. First, the standard economic analysis, which focuses on the employment effects of the minimum wage, would suggest that legislators representing areas with high unemployment would oppose raising the minimum wage. Second, a higher minimum wage makes firms in high wage areas more competitive with firms with lower labor costs and should be supported by congressmen from high wage states. Third, raising the minimum wage improves the bargaining position of unions and, therefore, should be supported by legislators from more unionized areas and by Democrats who rely more heavily than Republicans upon union support. Democrats may also favor the minimum wage for ideological reasons since it was one of the progressive reforms successfully enacted during the New Deal.

We use the model described in the previous section to analyze three Senate votes on the Fair Labor Standard Amendments of 1977 (S. 1871). The Labor and Human Resources Committee originally reported a bill containing indexing of the minimum wage. The indexing provision had been opposed in committee by Republicans, but an effort to eliminate indexing had been defeated in a party-line vote. Sometime between the time the committee reported the bill and when it was introduced on the floor, the committee chairman, Harrison A. Williams, reached an agreement with the ranking minority member, Jacob K. Javits, that they would sponsor an amendment replacing indexing by a specified four step increase

in the minimum wage. Given then current inflation forecasts, the Williams substitute would have accomplished what indexing was intended to do: raise the minimum wage to $2.65 per hour in 1978, $2.90 in 1979, $3.15 in 1980, and $3.40 in 1981. (In retrospect, inflation far exceeded 1977 expectations, so that indexing would have had rather different results. However, even critics of indexing, such as Senator John Tower who described the Williams amendment as "back-door indexing" that would "eliminate the formula, but keep the results," did not foresee the inflationary spiral of the late seventies.) It is doubtful that a bill incorporating indexing could have passed. Senate moderates were strongly opposed to indexing and the House had already defeated an indexing provision. Indexing was effectively dead, so the practical alternatives were no minimum wage bill or one with a sequence of prespecified minimum wage increases. Williams undoubtedly would have preferred indexing of the minimum wage, but he compromised on the point without pressing the committee's point on the floor.

A unanimous consent agreement was reached that allowed debate on two additional amendments (see *Congressional Record*, October 7, 1977, p. 32697). We refer to these according to their authors, Bartlett and Tower. The first amendment, offered by Republican Dewey Bartlett, would have raised the hourly minimum wage by only twenty cents per year resulting in a $2.90 minimum by 1980. The Bartlett amendment was soundly defeated in a 72-17 vote. Subsequently Tower proposed the same sequence of increases the House had passed (resulting in a $3.05 minimum wage in 1980). This compromise was also rejected, though the margin of defeat was narrower (60-32). After one additional vote (on an unprinted amendment), the Senate then approved the Williams amendment by an overwhelming margin of 76–14.

The two key votes that are used to estimate ideal points were those on the Bartlett and Tower amendments. Both amendments were offered in the hope of finding a compromise minimum wage level below that agreed upon by committee members Williams and Javits. As described in the preceding section, the most preferred minimum wage level for each legislator is taken to be a function of some observable characteristics of the legislator and of his or her constituency. For this analysis, legislator characteristics consist of the Senator's party (Democrats = 1, Republicans = 0) and region (southerners = 1, others = 0). The following constituency variables were used: average manufacturing hourly wage in each

state, percent of labor force belonging to labor unions, and percent nonwhite of population.

Table 2 presents estimates for different models of preferences over minimum wage levels. The implicit "dependent variable" for each equation is the Senator's ideal point on most desired minimum wage level. A predicted ideal point can be computed for each Senator by multiplying each coefficient by the value of the corresponding variable for the Senator in question and summing. The parameter σ is the estimated standard deviation of ideal points around their predicted values. On the whole, the equations appear to fit reasonably well. A 95% confidence interval around the predicted ideal points brackets points only \$0.20 higher or lower than the predicted ideal point, while over 70% of the three possible voting patterns are correctly predicted *ex post.*

[Table 2 here]

The first equation in Table 2 relies primarily on economic variables as determinants of Senatorial preferences. Overall, the estimated effects of the economic variables are quite small. A ten percent increase in the percent of labor force belonging to unions increases the desired minimum wage level by a little more than \$0.04, while a \$1.00 increase in average manufacturing wage increases the desired minimum wage by only \$0.03. Neither of these effects is very precisely estimated. The estimated unemployment effect is statistically significant but so small as to be of no consequence.

The second equation substitutes region and percent black for the wage and employment variables. The "political" variables appear to be better predictors of Senatorial preferences, as indicated by the increase in the log likelihood. Southern Senators are estimated to favor a minimum wage \$0.10 lower than non-southerners. The estimated effect of representing more blacks is positive, but insignificant. Also note that the estimated union effect is almost twice as large in this equation as the previous one.

The third equation combines both sets of variables. Given the small sample size, it is difficult to obtain precise estimates, but the union and region effects hold up. The estimated unemployment coefficient is much larger (a one percent increase in unemployment is estimated to increase the desired wage by about \$0.01) but still insignificant. The other coefficients (except for party) are small and insignificant.

In all three equations, a substantial party effect is present with Democratic Senators preferring a minimum wage of \$0.17 to \$0.22 higher than Republicans. Overall, there

TABLE 2

Maximum Likelihood Estimates

	(1)	(2)	(3)
Constant	2.705 (0.412)	2.921 (0.061)	2.816 (0.145)
Party	0.169 (0.036)	0.219 (0.047)	0.221 (0.005)
Union x 100	0.438 (0.324)	0.815 (0.280)	0.601 (0.335)
Wage	0.029 (0.026)	—	0.016 (0.027)
Unemployment x 100	0.020 (0.012)	—	1.134 (1.244)
South	—	-0.102 (0.061)	-0.107 (0.061)
Black	—	0.002 (0.002)	-0.002 (0.002)
σ	0.105	0.098	0.097
log L	-54.3	-49.7	-49.1
Percent correctly predicted	73.9	75.0	76.1

appears to be little evidence than preferences over minimum wages are particularly sensitive to wage and employment considerations suggested by traditional microeconomic analyses. We do, however, find substantial party, regional and unionization effects.

What, then, can be inferred about committee power on the Senate's minimum wage decision? The strategic situation for the committee was typical for the Senate. Committee members expected amendments to be offered on the floor. The unanimous consent agreement, negotiated informally by committee and Senate leaders prior to consideration of the bill, confirmed the committee's procedural expectations. The strategic situation on the floor was defined by information contained in the UCA and bill managers' statements regarding the sequence of proposals on which votes would be taken.[13] Three empirical questions emerge from this setting and reveal necessary conditions for committee power.

1. Did committee and parent chamber preferences diverge (as reflected by their respective median voters)?
2. Did the committee anticipate favored treatment of its bill and hence report a bill coincident with its, rather than the parent chamber's, median position?
3. Did the parent chamber permit the exercise of committee power by either refusing to offer anti-committee amendments or by rejecting them?

An estimated ideal point $\hat{x}_i = z_i'\hat{\gamma}$ was generated for each legislator using equation (2) and each set of estimates reported in Table 2. The median position in the Senate and in the Committee on Labor and Human Resources was estimated using the median of the estimated ideal points for each group.[14]

Table 3 presents the results and shows that of the three necessary conditions for committee power, only the first is satisfied. Estimated committee and parent chamber median ideal points differed by 10 to 17 cents. In spite of the strategic opportunities posed by committee-floor differences, and contrary to the second condition, the committee's proposed bill of a $3.15 per hour minimum wage (in 1980) actually *undershot* the chamber median according to all three sets of estimates. Finally, in light of these estimates, the amendment activity

[13] This common knowledge of the agenda poses the possibility of sophisticated voting on the floor. However, as noted above, elsewhere we test and reject the sophisticated voting hypothesis on these votes (Krehbiel and Rivers, 1985).

[14] Krehbiel and Rivers (1985, Appendix B) show that this procedure produces consistent estimates of the group medians.

on the floor refutes even more strongly the committee power hypothesis. The offering of anti-committee amendments suggests the absence of deference or committee power. More subtly, the failure of the parent chamber to pass these amendments cannot be interpreted as unambiguous support for the committee, because the committee had already converged to the approximate floor median.

[Table 3 here]

IV. Multidimensional Bills

The model described in Section II assumes that bills can be located in a unidimensional space. In this section, we demonstrate how the same approach can be adapted to two or higher dimensional bills. The appropriate estimation procedure turns out to be multivariate probit analysis (Ashford and Sowden, 1970), though some special issues arise in this model.

We consider a sequence of bills $\theta_1, ..., \theta_m$ which are voted in some prescribed order. In the first vote θ_1 is paired against an alternative $\tilde{\theta}_1$, in the second vote θ_2, is paired against $\tilde{\theta}_2$ and so. In general, $\tilde{\theta}_j$ will be determined by the form of the agenda tree and the outcomes of prior votes. Instead of the bills being representable as points on a line, the bills will be points in p-dimensional Euclidean space:

$$\theta_j = (\theta_j^1, ..., \theta_j^p)' \qquad \tilde{\theta}_j = (\tilde{\theta}_j^1, ..., \tilde{\theta}_j^p)'$$

Initially, we will assume that the bill positions are known, though later we indicate how it is possible to discard this assumption. Each legislator possesses an ideal point $x_i \in R^p$ representing his or her most preferred alternative:

$$x_i = (x_i^1, ..., x_i^p)'$$

Legislators prefer outcomes "closer" to their ideal points. Assuming again that legislators vote sincerely, legislator i will vote for bill θ_j over the alternative $\tilde{\theta}_j$ if θ_j is closer to his or her ideal point x_i than $\tilde{\theta}_j$, that is:

$$\| x_i - \theta_j \| < \| x_i - \tilde{\theta}_j \|, \qquad (3)$$

TABLE 3

Estimates of Committee and Parent Chamber Medians*

	(1)	(2)	(3)
Chamber	\$3.18	\$3.16	\$3.17
Committee	\$3.28	\$3.33	\$3.34
Difference	\$0.10	\$0.17	\$0.17

*Proposals: committee's bill, \$3.15; Bartlett amendment, \$2.90; Tower amendment, \$3.05.

where $\| \cdot \|$ denotes the usual Euclidean norm: $\| x \| = \sqrt{x'x}$.[15] Figure 2 illustrates how the condition (3) partitions a two-dimensional policy space into voting regions.

[Figure 2 here]

Condition (3) is a somewhat stronger restriction on preferences than the symmetric utility assumption used in Section II. Specifically (3) requires that legislators have circular indifference contours in the p-dimensional policy space (also known as "Type I preferences"). Thus, dimensions are separable and weighted equally. Alternatively, legislators could use a "weighted distance" in evaluating different bills as in Davis and Hinich (1966). This adds an extra set of parameters to the problem. If the bill positions are known, the weights can be estimated subject to a normalization. If bill positions are unknown and need to be estimated, however, the weights will not be identified. To simplify the exposition, we focus on the case of Type I preferences.

The goal of estimation is to relate legislators' ideal points x_i, which are unobservable, to a set of observable legislator characteristics z_i. The analog of equation (2) in the multi-dimensional case will be a set of regression-type equations, one for each dimension in the policy space:

$$x_i^j = \gamma_j' z_i + \epsilon_i^j \quad (i = 1, ..., n;\ j = 1, ..., p) \tag{4}$$

Of course, different explanatory variables can be used in the equations for ideal points in different dimensions by restricting elements of γ_j to be zero, but there is no point in complicating the notation to indicate this possibility. The errors $\epsilon_i = (\epsilon_i^1, ..., \epsilon_i^p)'$ are assumed to have a multivariate normal distribution with zero mean vector and positive definite covariance matrix Σ, independent of z_i.

Initially consider the conditions on ideal points implied by the possible voting patterns in the first two roll calls. Table 3 shows the implied restrictions on ideal points. Substituting equation (4) into the expressions in the upper left hand cell of Table 3 gives the following conditions for voting "Yes" on both roll calls:

$$(\tilde{\theta}_1 - \theta_1)'\Gamma'\epsilon_i \leq \frac{1}{2}(\| \theta_1 \|^2 - \| \tilde{\theta}_1 \|^2) - (\tilde{\theta}_1 - \theta_1)'\Gamma' z_i \tag{5}$$

[15] The condition in (3) is equivalent to assuming that legislator i's utility function takes the form $u_i(\theta_j) = \phi_i(\| x_i - \theta_j \|)$, where ϕ_i is any strictly decreasing function. Thus, (3) reduces to equation (1) in the unidimensional case.

$$(\tilde{\theta}_2 - \theta_2)'\Gamma'\epsilon_i \leq \frac{1}{2}(\| \theta_2 \|^2 - \| \tilde{\theta}_2 \|^2) - (\tilde{\theta}_2 - \theta_2)'\Gamma' z_i \tag{6}$$

where $\Gamma = (\gamma_1, ..., \gamma_p)$. (Similar expressions can be derived for the other possible voting patterns.) Let $A = (\tilde{\theta}_1 - \theta_1, \tilde{\theta}_2 - \theta_2)'$ and $\delta_j = \frac{1}{2}(\| \theta_j \|^2 - \| \tilde{\theta}_j \|^2)$. The joint probability of conditions (5) and (6) holding simultaneously (conditional on z_i) is given by the bivariate normal orthant probability:

$$\text{Prob(Yes,Yes)} = \Phi(\delta_1 - (\tilde{\theta}_1 - \theta_1)'\Gamma' z_i, \delta_2 - (\tilde{\theta}_2 - \theta_2)'\Gamma' z_i; A'\Gamma'\Sigma\Gamma A) \tag{7}$$

where:

$$\Phi(h, k; \Omega) = (2\pi)^{-1}|\Omega|^{-1/2} \int_{-\infty}^{h} \int_{-\infty}^{k} \exp\{-\frac{1}{2}(u, v)\Omega^{-1}(u, v)'\} dv du$$

The probability in (7) is in the form of a bivariate probit model with cross-equation restrictions. At present little software is available for this type of estimation, but the problem is well within the bounds of current numerical computational capabilities.

It is apparent from equation (7) that with only two votes, it will be possible to estimate ideal points on at most two dimensions. If the columns of A are dependent, even this will not be possible as $A'\Gamma'\Sigma\Gamma A$ will be singular and the dimensionality of the probability in (7) can be reduced. The critical issue is the degree to which the voting directions $\tilde{\theta}_j - \theta_j$ span the policy space. In the general m-vote case, where $A = (\tilde{\theta}_1 - \theta_1, ..., \tilde{\theta}_m - \theta_m)$ has full column rank, it will be possible to estimate ideal points in up to m dimensions.

The expressions for the voting probabilities in the general case require a little more notation. Let d_{ij} be a dummy variable taking the value +1 if legislator i votes for θ_j over $\tilde{\theta}_j$ and the value −1 if legislator i votes for $\tilde{\theta}_j$ over θ_j. The condition for a "Yes" vote on the jth roll call is:

$$\epsilon_i'(\tilde{\theta}_j - \theta_j) \leq \frac{1}{2}(\| \tilde{\theta}_j \|^2 - \| \theta_j \|^2) - (\tilde{\theta}_j - \theta_j)\Gamma' z_i \tag{8}$$

while the condition for a "No" vote is:

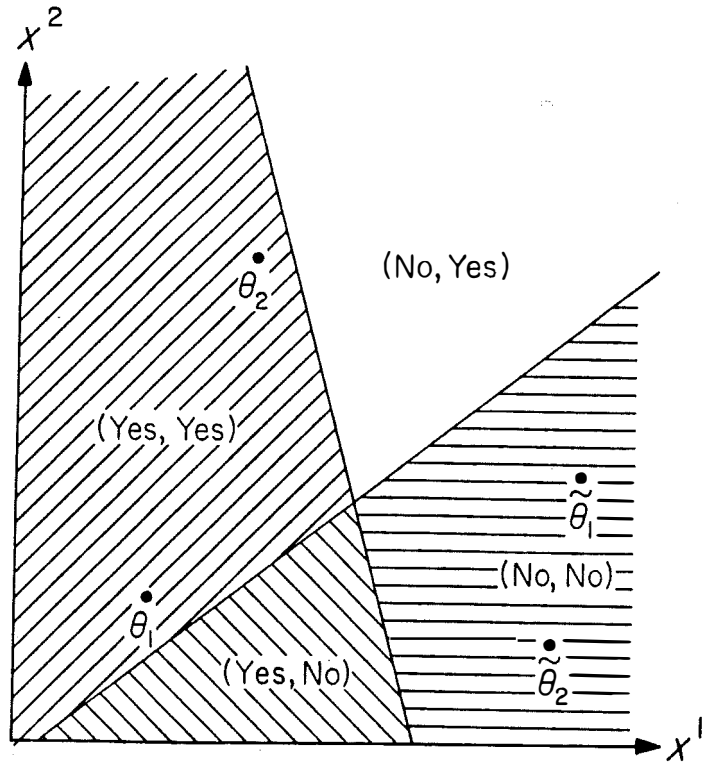
$$-\epsilon_i'(\tilde{\theta}_j - \theta_j) \leq \frac{1}{2}(\| \tilde{\theta}_j \|^2 - \| \theta_j \|^2) + (\tilde{\theta}_j - \theta_j)'\Gamma' z_i \tag{9}$$

Combining (8) and (9) gives the condition implied by the voting behavior d_{ij}:

$$d_{ij}\epsilon_i'(\tilde{\theta}_j - \theta_j) \leq \frac{1}{2}(\| \tilde{\theta}_j \|^2 - \| \theta_j \|^2) - d_{ij}(\tilde{\theta}_j - \theta_j)'\Gamma' z_i \tag{10}$$

Figure 2

Location of Ideal Points in Two Dimensions by Voting Patterns



Let D_i be a diagonal matrix with d_{ij} as its jth diagonal element and $\delta = (\delta_1, ..., \delta_m)$. From (10) we obtain the probability for a particular voting pattern $(d_{i1}, ..., d_{im})$:

$$\text{Prob}(d_{i1}, ..., d_{im}) = \Phi_p(\delta - D_i A'\Gamma' z_i; D_i A'\Gamma'\Sigma\Gamma A D_i) \tag{11}$$

where $\Phi_p(t; \Omega)$ is the cumulative distribution function of a p-variate normal random variable with mean zero and covariance matrix Ω evaluated at the point $t \in R^p$.

If the bill positions θ_j are unknown, then equation (11) can be estimated as an unconstrained multivariate probit model. A set of coefficients of z_i will be estimated for each category of the dependent variable (i.e., for each voting pattern). Each coefficient vector (apart from the category-specific constant) will correspond to a column of ΓA. Thus, we are confronted with a rotational problem similar to that encountered in factor analysis: unless there are *a priori* restrictions on the elements of Γ, the bill positions (in the matrix A) will be arbitrary.

The discussion in this section indicates a strategy for the estimation of legislative voting models in the case of multidimensional roll calls that generalizes the approach developed in Section II and applied to the minimum wage votes in Section III. As the dimensionality of the policy space increases, the computational requirements grow very quickly. But for a low-dimensional policy space (say two or three dimensions) the techniques proposed here should be feasible.

V. Discussion

The three primary objectives of this paper were to accentuate the need for measures of legislators' preferences, to discuss econometric techniques for deriving such estimates, and to apply the technique to a congressional situation that permits substantive inferences about committee power. This discussion treats these points in reverse order.

First, the substantive inferences about committee power during Senate consideration of minimum wage legislation are clear. The Committee on Labor and Human Resources was not powerful, and its bill received little if any deferential treatment on the Senate floor. Contrary to the sort of inferences that would be drawn from the committee's success in defeating hostile amendments, we find no evidence of committee power. In fact, the situation appears to have been exactly the opposite: the committee tailored its legislation

to fit the preferences of the median voter in the chamber. Although the main purpose for analyzing these votes was to demonstrate the technique rather than to test theories of committee power, the empirical results do have implications for the three classes of explanations discussed in Section II.

The Committee's informational advantage over the parent chamber seems to have been minimal. Minimum wage legislation had received congressional consideration on several prior occasions; numerous studies of the effects of minimum wage have been in the public domain for years and were cited during Senate debate; and Senators seemed to have clearly formed beliefs about the likely consequences of the policy alternatives on their constituents. Thus, even though the several members of the Committee could rightly be regarded as policy experts in some fields of labor and human resources, the minimum wage issue afforded no member "special expertise" or "private information" that would yield a prediction of committee power on this issue. In sum, this analysis offers only indirect support of informational explanations of committee power. Committee power did not exist where a pure expertise-based account says it should not exist. More convincing support requires analysis of situations in which the committee possesses private information.

The case is also not an ideal one for testing most institutional accounts of committee power because the Senate characteristically permits more open consideration of its committees' bills than the House. In unidimensional situations (such as the level of minimum wage provision), two-stage committee-floor models predict median outcomes, and the Senate's choice is consistent with this prediction of the model. For equation (3), the estimated floor median was \$3.17 and the bill was \$3.15. However, except under special cases,[16] institution-based spatial models make no predictions about committee behavior under the expectation of an open rule. So the results are weakly supportive. The committee had little procedural protection, defensively reported a bill near the floor median, and, consistent with the model, avoided taking a beating on the floor. But again, more convincing support requires comparative analysis of cases in which more restrictive treatment is given to committee's bills. The House is a natural place to turn.[17]

[16] See Krehbiel (1985).

[17] Of course, the analysis cannot be of the form: Are committees that receive restrictive rules more "powerful" than committees that receive open rule? One must keep in mind that choice of rules is endogenous.

The indirect, qualified support for informational and institutional explanations for committee power is contrasted by the strong evidence the minimum wage case provides against behavioral accounts of committee power. If pro-committee norms were dominant in the Senate, two things would have been observed: opportunistic behavior by the committee (e.g., reporting a bill that corresponded to its median—not the parent chamber's), and deferential behavior by Senators on the floor (either no amendments, or support of the committee if amendments were offered). Neither of these was observed, and doubt is thereby cast on the simple, norms-based account of committee power. Of course, all of these inferences are tentative, given the narrow scope of the paper and confinement to one set of votes. Nevertheless, they illustrate the potential of the technique for addressing questions of central concern to students of legislative behavior.

Second, we have illustrated that econometric techniques can provide useful estimates of legislators' preferences. Although we have indicated how our approach can be generalized to handle multidimensional policy spaces and unknown bill locations, it should be clear that the analysis cannot be mechanically repeated on hundreds of other roll calls. Considerable information about the nature of the choices facing legislators and how legislator preferences are related to their observable characteristics are required. While our approach lacks the generality of some scaling methods, it also avoids many of their indeterminancies. One ends up with fairly precise estimates of preferences that allow direct evaluation of how legislative outcomes corresponded to the preferences of the key players.

Finally, the paper began with an argument that adequate tests of theories about committee power often require estimates of legislators' ideal points. However, the correspondingly narrow substantive focus and application to the study of committee power *understates* the utility of the technique for attaining a better understanding of legislative politics. Invariably (albeit sometimes inexplicitly), theories of legislative politics are based at least in part upon legislator's preferences, be they induced via the electoral connection, dictated by powerful lobbyists, or purely ideology-based. Thus, any theory that yields predictions about the relationship between legislators' preferences and legislative choices stands to benefit from further development and application of techniques discussed here.

Appendix

In the main body of the paper, it was shown that legislator i will choose one of the following vote combinations depending on the value of his ideal point x_i:

$$\begin{array}{lll} \text{(Yes,Yes)} & \text{if} & x_i < (\theta_1 + \theta_3)/2 \\ \text{(No,Yes)} & \text{if} & (\theta_1 + \theta_3)/2 \leq x_i < (\theta_2 + \theta_3)/2 \\ \text{(No,No)} & \text{if} & x_i \geq (\theta_2 + \theta_3)/2 \end{array}$$

where:

$$x_i = z_i'\gamma + \epsilon_i$$

and $\epsilon_i = x_i - E(x_i|z_i)$. We will assume, in addition, that ϵ_i is normally independently distributed with mean zero and variance $\sigma^2 > 0$ and that the first component of z_i is identically equal to one. Let

$$\begin{aligned} y_i^* &= [x_i - (\theta_1 + \theta_3)/2]/\sigma, \\ \mu &= (\theta_3 - \theta_1)/2\sigma, \\ \beta_1 &= [\gamma_1 - (\theta_1 + \theta_3)/2]/\sigma, \\ \beta_j &= \gamma_j/\sigma \quad (j \geq 2) \end{aligned}$$

and:

$$y_i = \begin{cases} 0 & \text{if } i \text{ voted (Yes,Yes)} \\ 1 & \text{if } i \text{ voted (No,Yes)} \\ 2 & \text{if } i \text{ voted (No,No)} \end{cases}$$

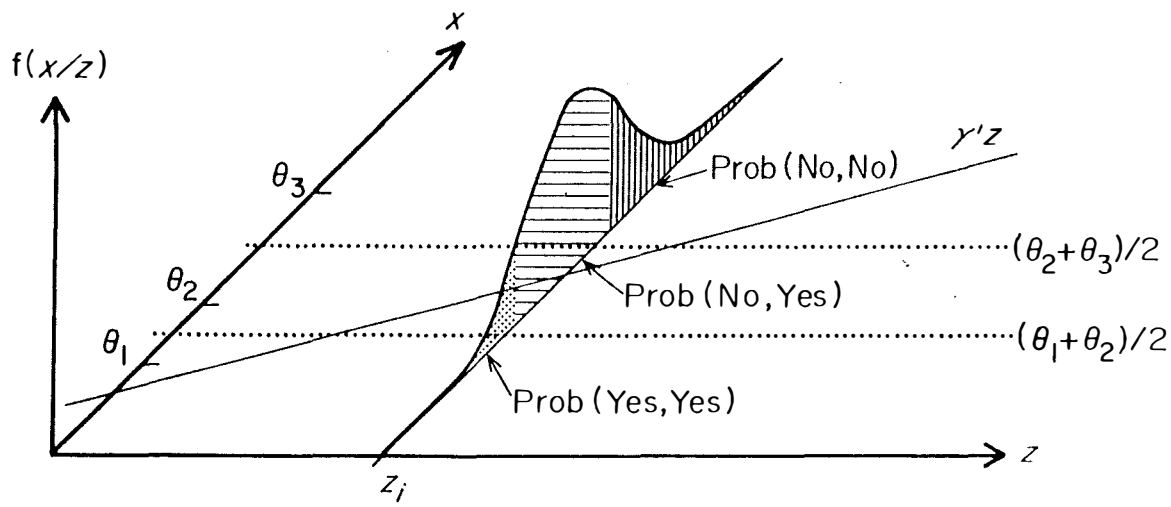
Then we have:

$$y_i = \begin{cases} 0 & \text{if } y_i^* > 0 \\ 1 & \text{if } 0 \leq y_i^* < \mu \\ 2 & \text{if } y_i^* \geq \mu \end{cases}$$

and the problem has been cast in the form of an ordered probit model (see Dubin and Rivers, 1986, pp. 78-80). Conditional on z_i, the distribution of x_i is shown in Figure 3.

Figure 3

Conditional Distribution of Ideal Points



By integrating the conditional distribution over the relevant regions, we can obtin the probability of each vot ng pattern for each legislator.

[Figure 3 here] .

Maximum likelihood estimates of β and μ, denoted $\hat{\beta}$ and $\hat{\mu}$. respectively, can be obtained by maximizing the log-likelihood:

$$L_n(\beta,\mu) = \sum_{y_i=0} \log\ \Phi(z_i'\beta) + \sum_{y_i=1} \log\ [\Phi(\mu - z_i'\beta) - \Phi(z_i'\beta)] + \sum_{y_i=2} \log\ \Phi(z_i'\beta - \mu)$$

These estimates are consistent and asymptotically normally distributed with asymptotic covariance matrix $R(\beta,\mu)^{-1}$, where $R(\beta,\mu)$ denotes Fisher's information matrix:

$$R(\beta,\mu) = \begin{pmatrix} R_{\beta\beta} & R_{\beta\mu} \\ R'_{\beta\mu} & R_{\mu\mu} \end{pmatrix}$$

$$R_{\beta\beta} = -E\left(\frac{\partial^2 L_n(\beta,\mu)}{\partial\beta\partial\beta'}\right)$$

$$R_{\beta\mu} = -E\left(\frac{\partial^2 L_n(\beta,\mu)}{\partial\beta\partial\mu}\right)$$

$$R_{\mu\mu} = -E\left(\frac{\partial^2 L_n(\beta,\mu)}{\partial\mu^2}\right)$$

Differentiation of L_n is straightforward, though expressions for the Hessian may also be found in textbooks (e.g., Madalla, 1983, pp. 48-49). In the above expressions, z_i can be taken as random (in which case, the expectation is taken with respect to the joint (y_i, z_i) distribution) or as a non-random square summable sequence.

Once consistent estimates $\hat{\beta}$ and $\hat{\sigma}^2$ of β and σ^2 have been obtained, it is straightforward to obtain estimates of $E(x_i|z_i)$ for each legislator:

$$\hat{\sigma} = (\theta_3 - \theta_1)/2\hat{\mu}$$

$$\hat{\gamma}_1 = \hat{\sigma}\hat{\beta}_1 + (\theta_1 + \theta_2)/2$$

$$\hat{\gamma}_j = \hat{\sigma}\hat{\beta}_j \quad (j \geq 2)$$

$$\hat{x}_i = z_i'\hat{\beta}$$

Note that $\hat{x}_i$ is a consistent estimator of $E(x_i|z_i)$. We may be interested in estimating order statistics such as the median of x_i for some set of legislators. It is easy to show that the median of $\hat{x}_i$ for the group is a consistent estimator as the size of the group increases. This means that if the group size is large, we are justified in using the median of the estimated ideal points as an estimator of the median position in the group. (See Krehbiel and Rivers, 1985 for details.)

Computation of standard errors for the parameter estimates is accomplished using the multivariate δ method (Bishop, Fienberg, and Holland, 1975, pp. 492-494). First, note that:

$$\frac{\partial\gamma}{\partial\beta'} = \sigma I$$

$$\frac{\partial\gamma}{\partial\mu} = -\frac{\theta_3 - \theta_1}{2\mu^2}\beta = \frac{\sigma}{\mu}\beta$$

It follows that the asymptotic variance of $\hat{\gamma}$ is given by:

$$\begin{aligned} V(\hat{\gamma}) &= \frac{\partial\gamma}{\partial\beta'}V(\hat{\beta})\frac{\partial\gamma'}{\partial\beta} + \frac{\partial\gamma}{\partial\beta'}C(\hat{\beta},\hat{\mu})\frac{\partial\gamma'}{\partial\mu} \\ &+\frac{\partial\gamma}{\partial\mu}C(\hat{\mu},\hat{\beta})\frac{\partial\gamma'}{\partial\beta} + V(\hat{\mu})\frac{\partial\gamma}{\partial\mu}\frac{\partial\gamma'}{\partial\mu} \\ &= \sigma^2 V(\hat{\beta}) - \frac{\sigma^2}{\mu}C(\hat{\beta},\hat{\mu})\beta' - \frac{\sigma^2}{\mu}\beta C(\hat{\beta},\hat{\mu}) \\ &+\frac{\sigma^2}{\mu^2}V(\hat{\mu})\beta\beta' \end{aligned}$$

Finally, using the partitioned inverse formula and substituting, we obtain:

$$V(\hat{\gamma}) = \sigma^2\left[R_{\mu\mu}M + \frac{1}{\mu}(MR_{\beta\mu}\beta' + \beta R'_{\beta\mu}M) + \left(\frac{1 + R'_{\beta\mu}MR_{\beta\mu}}{\mu^2 R_{\mu\mu}}\right)\beta\beta'\right]$$

where $M = (R_{\beta\beta} - R_{\beta\mu}R'_{\beta\mu})^{-1}$. Note that $R_{\mu\mu}M$ is the asymptotic covariance matrix of $\hat{\beta}$.

When the bill positions θ_1, θ_2, and θ_3 are unknown the above calculations will no longer be feasible. However, except for its first component (the coefficient of a constant term), γ

is proportional to β. Thus, even when bill locations are unknown, it will still be possible to analyze the relationship between legislator ideal points and their characteristics.

References

Aitchison, J., and S. Silvey. 1957. The Generalization of Probit Analysis to the Case of Multiple Responses. *Biometrika,* 44: 131-40.

Ashford, J.R., and R.R. Sowden. 1970. Multivariate Probit Analysis. *Biometrics,* 26: 535-46.

Austen-Smith, David, and William H. Riker. 1987. Asymmetric Information and the Coherence of Legislation. *American Political Science Review,* forthcoming.

Bach, Stanley. 1985. Representatives and Committees on the Floor: Amendments to Appropriations Bills in the House of Representatives, 1963-82. Presented at the annual meeting of the American Political Science Association. New Orleans, LA.

Bishop, Yvonne, Stephen Fienberg, and Paul Holland. 1975. *Discrete Multivariate Analysis.* Cambridge: M.I.T. Press.

Brown, Charles, Curtis Gilroy and Andrew Kohler. 1982. The Effect of the Minimum Wage on Employment and Unemployment. *Journal of Economic Literature,* 20: 487-28.

Cooper, Joseph S. 1970. *The Origins of the Standing Committees and the Development of the Modern House.* Houston: Rice University Studies.

Davis, Otto A., and Melvin Hinich. 1966. A Mathematical Model of Policy Formation in a Democratic Society. In Joseph L. Bernd, ed., *Mathematical Appoications in Political Science II.* Dallas: Southern Methodist University . pp. 175-205.

Denzau, Arthur T., and Robert J. Mackay. 1983. Gatekeeping and Monopoly Power of Committees: An Analysis of Sincere and Sophisticated Behavior. *American Journal of Political Science,* 27: 740-61.

Denzau, Arthur, William Riker, and Kenneth Shepsle. 1985. Farquharson and Fenno: Sophisticated Voting and Home Style. *American Political Science Review,* 79: 1117-34.

Dubin, Jeffrey A., and R. Douglas Rivers. 1986. *Statistical Software Tools: User's Guide.* Pasadena: Dubin-Rivers Research.

Dyson, James W., and John W. Soule. 1970. Congressional Committee Behavior on Roll Call Votes: The U.S. House of Representatives, 1955-64. *Midwest Journal of Political Science,* 14: 626-47.

Enelow, James M. 1981. Saving Amendments, Killer Amendments, and an Expected Utility Theory of Sophisticated Voting. *Journal of Politics,* 43: 1062-89.

Enelow, James M., and David H. Koehler. 1980. The Amendment in Legislative Strategy: Sophisticated Voting in the U.S. Congress. *Journal of Politics,* 42: 396-413.

Eulau, Heinz, and Vera McCluggage. 1984. Standing Committees in Legislatures: Three Decades of Research. *Legislative Studies Quarterly,* 9: 195-270.

Farquharson, Robin. 1969. *Theory of Voting.* London: Hodge.

Fenno, Richard F. 1966. *The Power of the Purse: Appropriations Politics in Congress.* Boston: Little, Brown.

Fenno, Richard F. 1973. *Congressmen in Committees.* Boston: Little, Brown.

Ferejohn, John. 1985. Logrolling in an Institutional Context: A Case Study of Food Stamps Legislation. Presented at the Caltech-Weingart Conference on Formal Voting Models. Pasadena, Ca.

Fiorina, Morris P. 1981. Universalism, Reciprocity, and Distributive Policy-Making in Majority Rule Institutions. In John Crecine, ed., *Research in Public Policy Analysis and Management.* Greenwich, CT: JAI Press. pp. 197-222.

Gilligan, Thomas W., and Keith Krehbiel. 1986. Rules, Jurisdictions and Outcomes: An Event Study of Energy Tax Legislation in the 93rd Congress. , Caltech: Pasadena, CA.

Gilligan, Thomas W., and Keith Krehbiel. 1987. Collective Decision-Making and Standing Committees: An Informational Rationale for Restrictive Amendment Procedures. *Journal of Law, Economics and Organization,* Forthcoming.

Huitt, Ralph K., and Robert L. Peabody. 1969. *Congress: Two Decades of Analysis.* New York: Harper and Row.

Ichimura, Hidehiko. 1986. Estimation of Single Index Models. Manuscript, M.I.T.: Cambridge, MA.

Krehbiel, Keith, and Douglas Rivers. 1985. Congressional Roll Call Voting Strategies: Application of a New Test to Minimum Wage Legislation. Presented at the annual meeting of the American Political Science Association. New Orleans, LA.

Krehbiel, Keith. 1985. Obstruction and Representativeness in Legislatures. *American Journal of Political Science,* 29: 643-59.

MacNeil, Neil. 1963. *Forge of Democracy: The House of Representatives.* New York: David McKay.

Madalla, G.S. 1983. *Limited-Dependent and Qualitative Variables in Econometrics.* New York: Cambridge University Press.

Manley, John F. 1970. *The Politics of Finance: The House Committee on Ways and Means.* Boston: Little, Brown.

Matthews,, Donald R. 1960. *U.S. Senators and Their World.* Chapel Hill: U.N.C. Press.

Mayhew, David. 1974. *Congress: The Electoral Connection.* New Haven: Yale University Press.

Poole, Keith T., and Howard Rosenthal. 1985. The Political Economy of Roll Call Voting in the 'Multi-party' Congress of the United States. *European Journal of Political Economy,* 1: 45-58.

Romer, Thomas, and Howard Rosenthal. 1978. Political Resource Allocation, Controlled Agendas, and the Status Quo. *Public Choice,* 33:27-43.

Ruud, Paul A. 1983. Sufficient Conditions for the Consistency of Maximum Likelihood Estimation Despite Misspecification of Distribution in Multinomial Discrete Choice Models. *Econometrica,* 51: 225-28.

Shepsle, Kenneth A. 1978. *The Giant Jigsaw Puzzle.* Chicago: University of Chicago Press.

Shepsle, Kenneth A., and Barry R. Weingast. 1981. Structure-induced Equilibrium and Legislative Choice. *Public Choice,* 37: 503-19.

Shepsle, Kenneth A., and Barry R. Weingast. 1987. The Institutional Foundations of Committee Power. *American Political Science Review,* Forthcoming.

Smith, Steven S., and Christopher J. Deering. 1984. *Committees in Congress.* Washington D.C.: Congressional Quarterly Press.

Smith, Steven. 1986. Revolution in the House: Why Don't We Do It On the Floor? Manuscript, Brookings Institution: Washington, DC.

Tullock, Gordon. 1970. A Simple Algebraic Logrolling Model. *American Economic Review,* 60: 419-26.

Weingast, Barry R. 1979. A Rational Choice Perspective on Congressional Norms. *American Journal of Political Science,* 23: 245-62.

Wilson, James Q. 1973. *Political Organizations.* New York: Basic Books.