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CONGRESSIONAL ROLL CALL VOTING STRATEGIES: APPLICATION OF A NEW TEST TO MINIMUM WAGE LEGISLATION

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INTRODUCTION

Congressional roll call voting usually is interpreted as a mixture of the preferences of individual congressmen and the preferences of their constituents. Preferences of the legislator are typically measured by characteristics such as party and ADA ratings, while constituency interests are measured by economic characteristics of congressional districts or states. The degree to which each set of characteristics predicts roll call voting is then taken as evidence of the influence of constituency interests and legislator's ideology, respectively. Increasingly, political scientists (and economists who have also taken an interest in this topic) understand that such interpretations are problematic because they ignore the institutional context in which the behavior takes place. Use of characteristics of constituencies as measures of constituency preferences, for example, requires at least three strong assumptions:

(1) Constituency preferences on legislative proposals depend only upon the effects of such proposals on constituents' wealth (i.e., constituents lack ideological preferences).

(2) Congressmen respond only to the desires of the average or median voter (i.e., constituencies are not composed of coalitions, contributors, or other groups that may influence the MC disproportionately).

(3) Roll call votes are honest or "sincere" revelations of legislators' preferences, whatever the source of such preferences (such as electoral incentives, personal ideology, etc.).

Three classes of research illustrate the implicit reliance on assumption (3), which is the focus of this paper. The first includes the works of Jackson (1971, 1974), Kingdon (1973) and Ferejohn (1974) and addresses whether, how, and how strongly individual votes are affected by constituencies, parties, leaders, interest groups, staff, the president, and the media. Kingdon's more recent study (1977) synthesizes some earlier findings, while an emerging set of studies assesses the relative effects of economic self-interest versus ideology as predictors of roll call votes. (See, for example, Kau and Rubin, 1979; Kalt, 1981; Kalt and Zupan, 1984; Silberman and Durden, 1976; Pashigian 1982; Silberberg and Nelson, 1984; and Peltzman 1984). A second, older, but continuing line of research focuses on dimensions of conflict and voting alignments in Congress. MacRae (1958) introduced this field, and its continuing interest to political scientists is evident in Clausen (1973), Sinclair (1977), Asher and Weisberg (1978), Schneider (1979), Smith (1981), and Poole (1981). Finally, a third class of research addresses the use of available data. MacRae (1965) designed a technique for using roll call votes to identify issues and factions, and Morrison (1972) and Clausen and Van Horn (1977) continued the study of how to make the best use of voting data. Weisberg (1978) discusses various criteria for evaluating models that predict congressional votes. And most recently, Carson and Oppenheimer (1984) have questioned applications of interest group ratings to answer the question of economic self-interest versus ideology.

The range of issues addressed in such literature is impressive, but the more fundamental question represented by assumption (3) is largely ignored. When, and to what degree, do roll call votes unambiguously reflect the preferences of political actors? This question has not been completely overlooked (see Riker, 1958; Bjurulf and Niemi, 1978; Enelow and Kochler, 1980; Enelow, 1981; and Denzau, Riker and Shepsle, 1985), but the exceptions face a common problem: to assess the voting strategies of MCs one needs to know MCs' preferences. Traditionally this need is met either by seeking guidance of interest group ratings (e.g. ADA scores), or by making informed but necessarily ad hoc case-by-case assertions about members' true preferences. The former approach is of course dubious inasmuch as the assumption of honest revelation is imbedded in interest group ratings, too, while the latter precludes systematic empirical study of roll call voting strategies.

In this paper we introduce and employ a new and promising approach. Part 1 discusses the institutional context in which revelation of preferences might not be straightforward and shows how "agenda trees" in the contemporary House and Senate often can be represented as multi-stage "decision trees" that are more tractable

theoretically. Part 2 introduces a random expected utility model which incorporates some natural econometric tests of sincere versus sophisticated voting, yet does not rely upon interest group ratings or assertions about members' preference orderings. Part 3 applies some of the new estimation techniques to Senate voting on minimum wage legislation in 1977. And part 4 offers some suggestions for further applications of random expected utility models to questions of legislative strategy in institutionally richer settings.

1. THE INSTITUTIONAL CONTEXT OF ROLL CALL VOTING

Institutions such as the United States Congress are sufficiently complex to provide ample opportunities for members not only to behave in puzzling ways but also to benefit from such behavior. For example, if a member of Congress wants to initiate a policy, rarely is it in his best interest to propose legislation that enacts the policy in the precise manner that he most prefers (Enelow, 1984). More likely, his desire to get some policy enacted is better served by reducing benefits or distributing them to a greater number of recipients (Arnold, 1979). A similar but more frequent strategic choice of MCs is how to vote on legislation at various stages in the legislative process. The similarity is that MCs often may find it advantageous in the long run to vote against proposals (or parts of proposals) they genuinely favor--a strategy formally characterizable as "sophisticated voting" (Farquharson, 1969). Invariably, such opportunities to benefit from behavior that is ostensibly contrary to one's wishes are attributable to concrete institutional features that determine how, when, and by whom preferences can be expressed. For roll call voting decisions the relevant institutional features are the rules governing the amendment process.

While the complexity of the amendment process in Congress is undeniable, it can be translated into a tractable decision-theoretic problem. The translation requires knowledge of key institutional details and application of some basic theoretical tools. The tools we adopt for describing and studying the details of the amendment process are amendment trees and decision trees (or formal agendas). The amendment tree can be thought of as a diagram that represents the possibilities for modifying legislation under normal congressional procedures, while the decision tree is a representation of the actualities of a particular legislative situation. As it turns out we do not need to worry about all such subtleties for the test presented in this paper. Nevertheless we introduce them as a guide for future applications.

For expository purposes it is sufficient to focus on the normal procedure in the House when it acts as Committee of the Whole under its normal germaneness rule (Rule XVI, clause 7, section 794). (This situation is not fundamentally different from that of the Senate. The House typically votes on a special rule that specifies the conditions of debate and amendment (see Bach, 1981) while the Senate reaches such agreement more informally via unanimous consent (Keith, 1977). Also, the Senate's amendment tree contains more branches and generally constrains members less.)

The House usually considers bills section by section, as shown in Figure 1. Each section of the bill may receive modifications in the form of amendments, substitutes to amendments, amendments to amendments, and amendments to substitutes (but not amendments to amendments to amendments, which, being modifications "to the third degree" are prohibited by rule XIX, section 823). These motions are then voted on in an established order: first the amendment to the amendment (to perfect the amendment), then the amendment to the substitute (to perfect the substitute), then the substitute (possibly as amended), and then the first degree amendment (possibly as amended or substituted). After repeating this for all sections, members vote on final passage. This may take rather implicit forms such as a motion to strike the enacting clause, to table, or to recommit.

Associated with any given amendment tree is a decision tree. Suppose that for the kth section of a bill, all four of the motions in Figure 1 are offered. The theoretical representation of that fully grown section of the amendment tree is the decision tree (of formal agenda) in Figure 2, where:

x_1 is the unamended kth section of the bill

x_2 is the amendment (first degree) to x_1

x_3 is the substitute amendment (first degree) for x_2

x_4 is the (second degree) amendment to the amendment, x_2

x_5 is the (second degree) amendment to the substitute, x_3.

FIGURE 1

AMENDMENT TREE UNDER NORMAL
HOUSE RULES

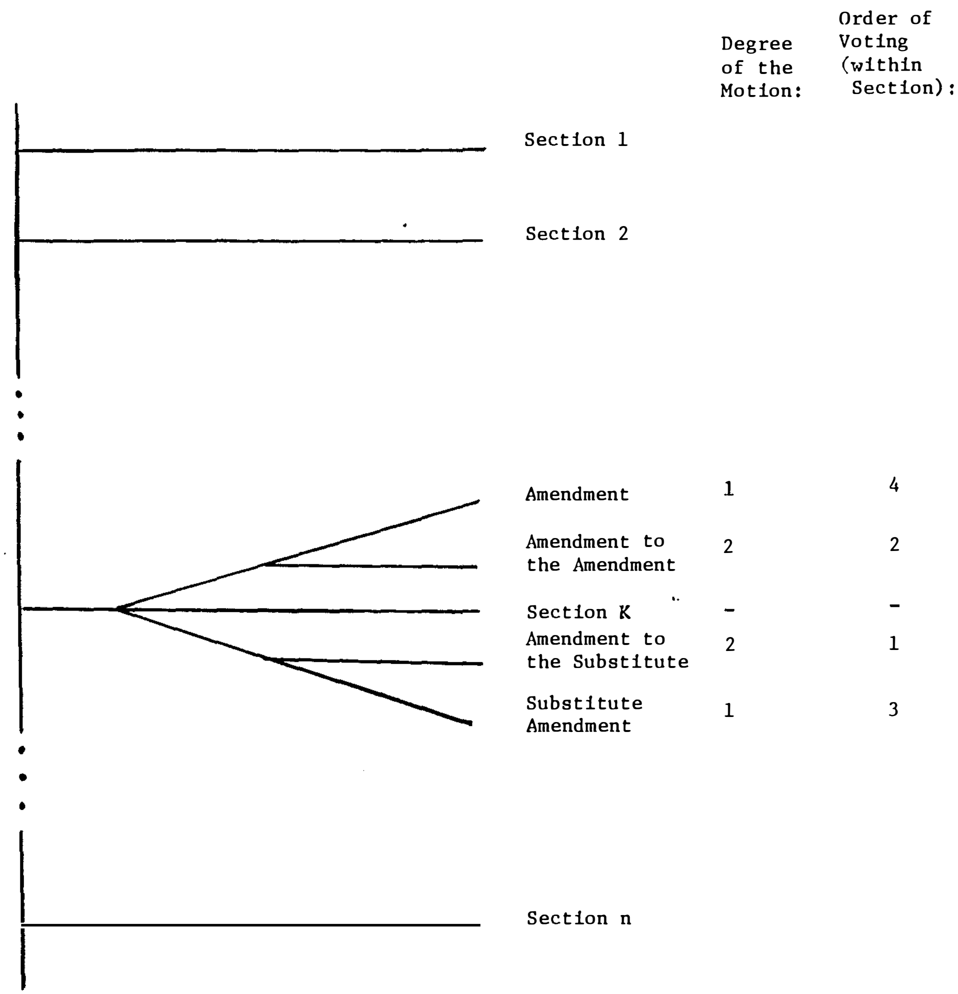
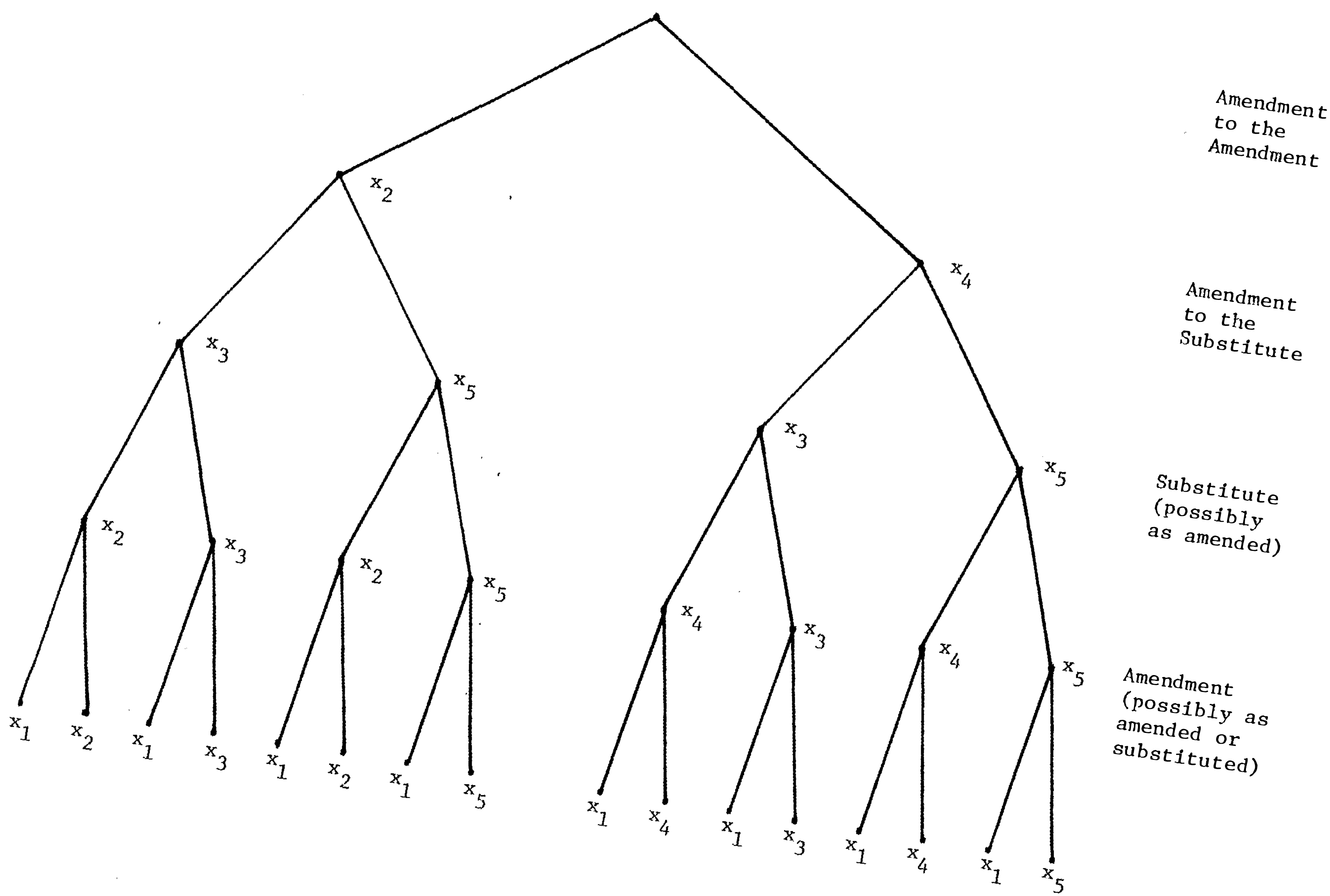


FIGURE 2

DECISION TREE FOR SECTION K OF FIGURE 1



The four levels of the tree denote four votes taken on the respective motions. Both theory and practice suggest that such agendas provide frequent incentives to vote contrary to what myopic or "sincere" preferences would dictate. Additionally, decision trees provide structure useful for conducting empirical tests, as we demonstrate for a simpler case later in the paper. But there are a few additional institutional features and associated caveats to consider prior to testing hypotheses on voting strategies.

First, notice that the votes on the "substitute" and the "amendment" (in stages 3 and 4 respectively) are not necessarily votes on the substance originally associated with such motions. Rather, the meaning of the terms often depends upon how voting transpires. For example, the fourth stage is nominally a vote on the amendment. However of the eight possible votes that may occur, the original amendment, x_2, appears in only two. In all other cases the actual vote is on the amendment as amended or as substituted (and similarly, the nominal substitute may have been amended in stage 2). As a practical matter then, when sifting through the Congressional Record or Congressional Quarterly to select votes, one must verify that the "vote of the Jones amendment" is not a vote on a substantially different amended version of the Jones amendment.

Second, the theory of sophisticated voting pertains to settings in which agendas are fixed. But of course legislative strategy consists not only of voting on exogenously imposed agendas but also of constructing agendas. This is especially likely in the

House under an open rule and in the Senate in the absence of a unanimous consent agreement. For example, suppose vote is taken on an amendment to a substitute. Figures 1 and 2 suggest that the next decision will be a vote on the substitute (possibly as amended), but actually a member may be recognized to propose another amendment to the substitute. Figuratively, branches of the tree, once pruned, can instantly grow back. Although theoretically this feature destroys the ability of voters to engage in sophisticated voting, it does not necessarily preclude empirical analysis. Increasingly, the House Rules Committee writes modified closed rules that contain provisions which have the collective effect of making the amendment and decision trees well-known (Bach, 1981; Krehbiel, 1985), and the use of complex unanimous consent agreements in the Senate can have the same effect. For analysis of voting strategies, then, it is advisable not only reconstruct the trees but also to study rules or UCAs to determine whether members had reasonable expectations about how the trees would evolve.

Third, for the sophisticated voting hypothesis to be plausible, the agenda tree should not be too complex. Figure 2 shows four votes, but realize that this is for only one section of the bill. Suppose there were five sections to the bill and for each section the amendment tree were filled once and then voted on. Theoretically, a prediction under sophisticated voting could be obtained. But as a practical matter it is difficult to sustain the argument that members would behave as if they computed sophisticated equivalents for each of the 2,097,151 nodes for the associated tree.[1] The more serious point is that initial tests should be conducted on simple trees.

Finally, the theory of sophisticated voting depends heavily upon voters being able to "work up the agenda tree"--from the final vote to the initial vote. But in legislative settings of possible sophisticated voting, it is sometimes difficult to define the relevant "final vote." For example, if such voting is on modifications of a section of a bill, is the "status quo" the present policy in the absence of any bill at all? (This is Enelow's (1981) assumption, for example.) Or is it the policy stated in the bill as reported by the committee? Since most bills that reach the floor pass, a plausible argument can be made for the latter characterization: members think the bill will pass, thus at the final vote on an amendment to a section, the relevant reversion point may be that contained in the bill--not the true status quo level. In the final analysis, there is no clear advice for this problem other than the obvious point that judgment is required.

In sum, our present purpose is not to solve all such problems associated with tests of voting strategies, but more modestly to draw attention to some institutionally important considerations.

2. TESTING SOPHISTICATED VOTING MODELS

Although anecdotal evidence exists that congressmen sometimes engage in sophisticated voting, the absence of a general method for testing sophisticated voting models has made it difficult to assess

the applicability of sophisticated voting models to congressional behavior. We will demonstrate that the theory of sophisticated voting and other formal theories of legislative behavior have testable implications, and we now propose an approach to empirical testing of such theories. The techniques are easily implemented and can potentially be applied to a wide variety of votes, even though the application in this paper is a relatively simple test of the sincere voting hypothesis.

The most severe shortcoming of previous empirical work on sophisticated voting is that it relies heavily on <u>ad hoc</u> restrictions on members' true preferences. That is, if it is possible to rule out certain voting patterns as inconsistent with any "true" preference ordering, then sincere voting can be tested by observing whether any of the inconsistent voting patterns occur. For example, consider voting on minimum wage legislation. If we assume that each congressman has a most preferred minimum wage level (including, possibly, <u>no</u> minimum wage) and that utility functions are single-peaked, then certain voting patterns are inconsistent with sincere voting. For instance, truthful reporting of preferences would not allow a member to vote for an amendment raising the minimum wage to a high level and also to vote for another amendment that reduces the minimum wage. With the assumption of single-peakedness it is possible to test for sophisticated behavior in a purely nonparametric way.

But there are several drawbacks to such a procedure. First, suppose one or two congressmen violate the sincere voting requirement, but all others vote in a way that is consistent with some allowable preference ordering. In some sense, such a violation is not very significant because at most two members could have engaged in sophisticated behavior. We would not want to perform a conventional test of significance here, however, since the rejection of the sincere voting model is not a statistical matter. Second, the technique is applicable to very few situations. In general, bills and amendments will differ on a wide variety of dimensions or, if the vote is believed to be on a single dimension, it will be difficult to order the alternatives in a way that eliminates any possible voting patterns. (It is for this reason that so much of the empirical literature on sophisticated voting has an anecdotal flavor.) Finally, even if the sincere voting hypothesis is rejected, we lack any test of the sophisticated voting model. Rejecting the null hypothesis of sincere behavior does not allow us to "accept" the alternative of sophisticated behavior, since both models may be incorrect. We show below that with our technique it is possible to treat sophisticated voting as the null model and then to test is against a general (unspecified) alternative.

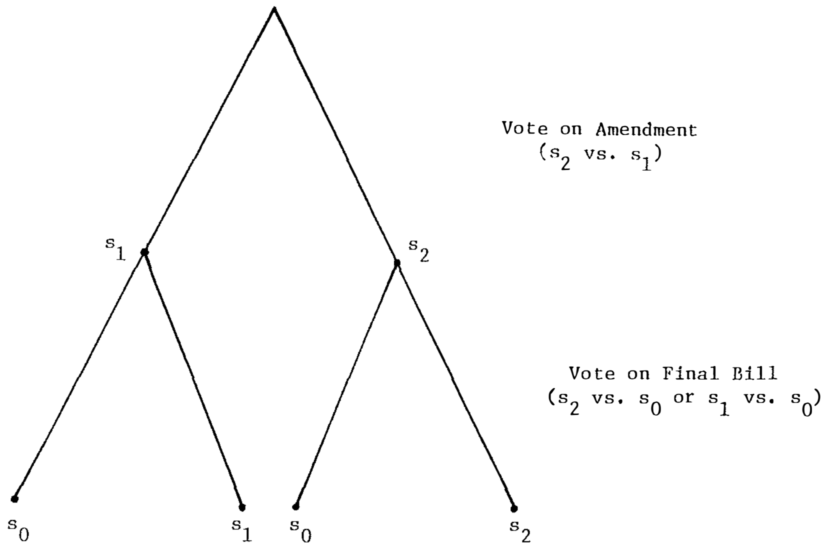
Our approach relies on a parametric specification of legislators' utility functions. This approach is now standard in econometrics (see McFadden, 1981) and provides a foundation for empirical work that is directly based upon individual utility maximization. Since a utility representation of preferences underlies almost all formal analyses of legislative institutions, the approach

is well suited to congressional roll call studies. For the sophisticated voting model, however, we modify the usual random utility setup to accommodate lottery alternatives. To our knowledge, this extension is original, though Enelow (1981) has used an expected utility model to analyze sophisticated voting. The main modification required is that the utility representation chosen for preferences be of the von Neumann-Morgenstern form so that legislators are expected utility maximizers.

Rather than develop models for a general agenda tree, for expository purposes we restrict ourselves to the simple case of a single amendment, illustrated in Figure 3. A bill (denoted s_1) is being considered by the legislature, but a perfecting amendment, if offered, will have precedence and therefore is voted upon first. There are four possibilities (leading to three distinct outcomes): the amendment may be adopted and the amended bill (denoted s_2) passes in a second vote; the amendment is adopted but the amended bill fails in the second vote, resulting in the status quo (denoted s_0); the amendment fails and the unamended bill (s_1) subsequently passes; or, the amendment fails and the unamended bill is also defeated, resulting again in the status quo (s_0). The probability that the amended bill passes in the second vote (given that the amendment is adopted in the first vote) will be denoted by p. Similarly, the probability that the unamended bill passes in the second vote (given that the amendment passed in the first vote) is given by q. These probabilities are assumed to be common knowledge, i.e. each legislator has the same

FIGURE 3

ILLUSTRATION OF SIMPLE AMENDMENT PROCESS



estimate of the probabilities of the outcomes of the second round of voting. This, of course, is a strong assumption, but, in our view, a reasonable one for an initial pass at the data. Unfortunately, we (as legislative analysts or statisticians) do not know these probabilities, but it is possible to estimate them.

Legislators are assumed to have von Neumann-Morgenstern utility functions $u_i(\cdot)$ defined over the possible states of the world:

$$\Omega = \{s_0, s_1, s_2\} \tag{1}$$

If the amendment passes on the first vote, legislator i's expected utility is:

$$qu_i(s_2) + (1 - q)u_i(s_0) \tag{2}$$

If the amendment fails on the first vote, his expected utility is:

$$pu_i(s_1) + (1 - p)u_i(s_0) \tag{3}$$

Legislators are assumed to vote for the outcome that results in the highest level of expected utility. Therefore, the condition under which legislator i will vote for the amendment in the first round of voting is:

$$qu_i(s_2) - pu_i(s_1) > (q - p)u_i(s_0) \tag{4}$$

Contrast this condition to the one that would result if legislator i behaved "sincerely," i.e. voted for the proposal (either the amended bill or the unamended bill) that gave him the highest level of utility relative to the alternative against which it was posed. In this case, the condition for voting for the amendment in the first vote is

$$u_i(s_2) > u_i(s_1), \tag{5}$$

because sincere voters, by definition, ignore the probable outcomes of successive votes.

Utilities, of course, are unobservable, but (4) and (5) nevertheless provide a basis for an econometric test of the sincere and sophisticated voting models. The utility of alternative j to legislator i depends on some measured characteristics of the legislator and the alternative, but these measured characteristics alone will not perfectly predict legislative choice since the legislator's utility function also depends on unmeasured characteristics of the bill or legislator. These unmeasured characteristics will, however, have a probability distribution. Therefore $u_i(s_j)$ is a random variable and we may write:

$$u_i(s_j) = v(z_i,s_j) + \varepsilon_{ij} \tag{6}$$

where z_i is a vector of the legislator's characteristics, $v(z_i,s_j)$ describes the representative or "strict" utility of state s_j to a legislator with measured characteristics z_i, and ε_{ij} captures the effects of unmeasured characteristics of legislators or bills that affect the legislator's preferences. A reasonable assumption is that

ε_{ij}'s are independently normally distributed with mean zero and variance σ_j^2, independent of z_i. Then, under the assumption of sophisticated voting, the probability that legislator i votes for the amendment is:

$$\Phi\left[\frac{qv(z_i,s_2) - pv(z_i,s_1) - (q - p)v(z_i,s_0)}{[(q - p)^2\sigma_0^2 + p_2\sigma_1^2 + q^2\sigma_2^2]^{1/2}}\right] \tag{7}$$

where $\Phi(\cdot)$ denotes the standardized normal distribution function. If a legislator votes sincerely, the probability that he or she votes for the amendment is:

$$\Phi\left[\frac{v(z_i,s_2) - v(z_i,s_1)}{(\sigma_1^2 + \sigma_2^2)^{1/2}}\right] \tag{8}$$

We have purposely left the form of $v(\cdot,\cdot)$ unspecified since the argument does not depend on the nature or source of the legislator's preferences. However, the empirical content of the sincere and sophisticated voting theories is more apparent if $v(\cdot,\cdot)$ is given some parametric form. In this paper, we consider the problem of estimating preferences over the minimum wage based on a series of roll call votes on proposals to set the minimum wage at various levels. In our analysis, we assume that each senator has a desired level of the minimum wage, denoted x_i:

$$x_i = \alpha + z_i'\beta \tag{9}$$

where z_i is a vector of state and senator specific characteristics (discussed later). Senators are assumed to have quadratic utility functions so that the strict utility of some minimum wage level θ_j to a senator with ideal point x_i is given by:

$$v(x_i,\theta_j) = -(x_i - \theta_j)^2. \qquad (10)$$

For two proposals, θ_j and θ_k, it follows that:

$$v(x_i,\theta_j) - v(x_i,\theta_k) = 2x_i(\theta_j - \theta_k) - (\theta_j^2 - \theta_k^2).$$

Substituting (9) into (10) yields:

$$v(x_i,\theta_j) - v(x_i,\theta_k) = 2(\theta_j - \theta_k)\alpha - (\theta_j^2 - \theta_k^2) + 2(\theta_j - \theta_k)z_i'\beta. \qquad (11)$$

Assuming random utilities are normally distributed, the probability senator i prefers the minimum wage θ_j to θ_k is (from (8)):

$$\text{Prob}(\theta_j \; R_i \; \theta_k) = \Phi(\tilde{\alpha} + \tilde{z}_i'\beta), \qquad (12)$$

In (12) we have imposed a variance normalization and used the following notation:

$$\tilde{\alpha} = 2(\theta_j - \theta_k)\alpha - (\theta_j^2 - \theta_k^2), \qquad (13)$$

$$\tilde{z}_i = 2(\theta_j - \theta_k)z_i,$$

and R_i is legislator is weak ordering over minimum wage levels. For a test of sincere voting, then, (12) can be estimated by probit analysis. Estimating the sophisticated voting model is somewhat more complicated, however. It is clear from (12) that with data on only

the initial vote, that the probabilities associated with the second vote are not identified. However, β can be consistently estimated by applying (12) to the final vote, and then the probabilities themselves could be estimated in a second step using the initial vote.

This last point suggests a natural specification test for the sincere voting model. Under the null hypothesis of sincere voting, β can be estimated by applying probit analysis to either the initial or final votes. Both estimates are consistent (and have the same probability limit) if voting is sincere. If voting is sophisticated, however, the two estimates of β will tend to different probability limits. In Appendix A we explain how a specification test can be constructed comparing the different estimates of β. In section 3 we apply this test to Senate roll call votes on minimum wage amendments in 1977.

Whether voting is sincere or sophisticated, the procedure described above allows us to estimate legislator preferences on the minimum wage. In particular, the expected vote for θ_j against θ_k (under sincere voting) can be consistently estimated using:

$$(1/n) \sum_{i=1}^{n} \Phi(2(\theta_j - \theta_k)\hat{\alpha}_n - (\theta_j^2 - \theta_k^2) + 2(\theta_j - \theta_k)z_i'\hat{\beta}_n)$$

provided $\hat{\beta}_n \xrightarrow{a.s.} \beta$. This enables us to determine what strategies were available to legislators given the estimated configuration of preferences. The same technique applies for sophisticated voting, with sophisticated equivalents replacing the stated provisions of the bills.

3. THE SENATE MINIMUM WAGE VOTES OF 1977

Congress first adopted a minimum wage of $.25 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 $.20 per hour increase to the 1977 minimum wage of $2.30 per hour. This increase was considerably less than labor's desired level of $3.00 per hour. Congress (and President Carter) eventually agreed to a more generous increase over four years (to $3.35 in 1981, where it remains today).

The minimum wage amendments of 1977 provide an interesting application of our analytic techniques. The politics of the minimum wage are not well understood and the estimates we report below indicate some political subtleties that are frequently ignored in economic analyses of the minimum wage. The Senate minimum wage votes are also convenient since a series of roll call votes concerned a single dimension of choice: at what level should the minimum wage be set? Estimates of preferences on this dimension are easily interpretable as dollar amounts. Although the decision tree associated with the amendment process makes it difficult to distinguish sincere and sophisticated behavior, this application does illustrate the utility of our approach for answering other questions about legislative strategy.

The debate on the minimum wage bill in 1977 involved old

arguments from both sides. Proponents argued that an increase was long overdue (the last increases were voted in 1974). At $2.30 per hour, the minimum wage would provide an annual income of only $4,800—below the poverty level for a family of four. By gradually raising the minimum wage to a point above the poverty line, they reasoned that poverty would be reduced. Opponents countered that raising the minimum wage does not necessarily raise anyone's wage, and that the more likely consequence would be to <u>reduce</u> employment. Conservatives' reasoning was that employers would lay off current workers, whose marginal revenue product would be less than the new mandated minimum--not by hiring persons currently unemployed (and especially not teenagers who have little or no labor market experience). In 1977 and 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 (which is little more than a textbook supply and demand analysis with price rationing), but rather who made it. Conservatives, not known for their concern about unemployment (teenage or otherwise), nevertheless based their arguments almost entirely on the bill's adverse effects on low wage workers and the unemployed. In the case of employment effects, conservatives clearly had the better of the argument. Simple economic logic, supported by countless empirical studies, demonstrates that the minimum wage reduces employment and hurts the employment prospects of the unemployed. Also uncharacteristically, liberals responded that the employment losses will be small and offset by the wage gains of employed workers.

Economists tend to dismiss the wage gains argument as another bit of political irrationality. Though it is possible, we think, to make an economically respectable argument for moderate increases in the minimum wage,[2] the standard economic analysis misses the essence of the <u>political</u> argument. The primary advocates of increasing the minimum wage are labor unions. Although unions tend to take liberal positions on poverty issues, on the minimum wage their preferences have a clear economic foundation. Had labor's proposal increase in 1977 been enacted, it probably would have had the substantial disincentive effects on employment that conservatives warn about whenever any minimum wage increase is discussed. (Small to moderate size increases, such as that finally adopted in 1977, appear to have minimal employment effects. Some low wage workers may benefit for the reasons cited in footnote 2, but wage inflation means that the real minimum wage stays constant or even falls so that the constraint turns out to be non-binding for most workers soon after its adoption.) The beneficiaries of a large increase in the minimum wage are workers already earning more than the proposed minimum, i.e., workers who are likely to belong to labor unions. Labor's position in bargaining is strengthened because a higher minimum wage raises the labor costs of nonunionized employers. Employers also have incentives to shift from low skill workers (whose marginal product would be less that the minimum wage) to higher skilled workers who are more likely to be represented by labor unions.

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 tend to have higher wage levels than southern and 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 increase can benefit northern states without having any direct effect upon their internal labor markets.

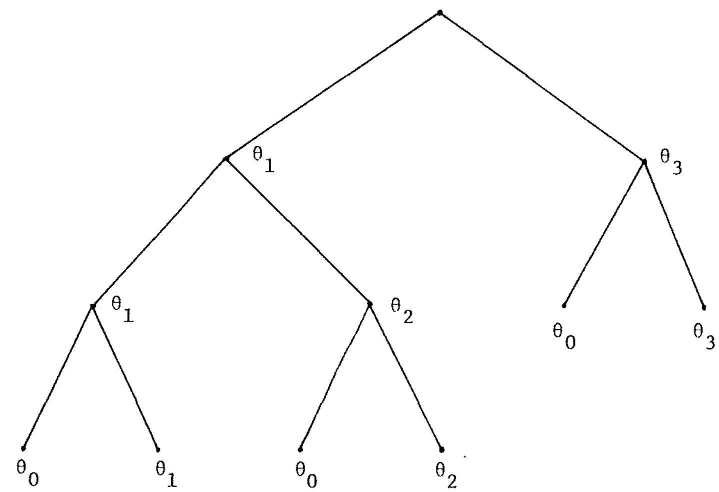
This brief discussion has identified several factors that might lead legislators to favor or oppose an increase in the minimum wage. First, the standard economic analysis, which focuses on the employment effects of the minimum wage, would suggest that legislators representing areas with high unemployment 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 implemented 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 Human Resources Committee originally reported a bill containing indexing of the minimum wage. However the indexing provision was defeated earlier in the House and was strongly opposed by Senate moderates. Senators therefore expected amendments on the wage increase provision of the bill. Moreover, a complex unanimous consent agreement was reached that specified two of the alternative proposals (see Congressional Record, October 7, 1977, p. 32697). We refer to these according to their authors--Williams and Bartlett--and interpret the situation as one in which the formal agenda is known.[3] The sequence of events, shown in figure 4, was as follows.

First, the ranking members of the Committee, Senators Harrison A. Williams and Jacob K. Javits, proposed an amendment that replaced indexing by a four step minimum wage increase which, given current inflation forecasts, would have accomplished what indexing was intended to do. The Williams amendment would increase 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" which would "eliminate the formula, but keep the results," did not foresee the inflationary spiral of the late seventies.) Indexing was effectively dead, so the practical alternatives were no minimum wage

FIGURE 4

AGENDA TREE FOR 1977 SENATE MINIMUM WAGE AMENDMENTS



θ_0	Status quo ($2.30)
θ_1	Williams amendment ($3.15)
θ_2	Tower amendment ($3.05, not offered if Bartlett passes)
θ_3	Bartlett amendment ($2.90)

bill or one with an sequence of specified minimum wage levels.

Before a vote was taken on Williams, Republican Senator Dewey F. Bartlett offered an amendment to the Williams amendment that would have raised the minimum wage by $.20 per year from its 1977 level of $2.30 to $2.90 by 1980. The Senate defeated the Bartlett amendment 72-17. Subsequently, Senator Tower proposed the same sequence of increases which the House had passed earlier (resulting in a $3.05 minimum wage in 1980), but this amendment was also defeated (by 60-32). After one additional vote (on an unprinted amendment), the Senate then approved the Williams amendment by an overwhelming 76-14 margin.

We first estimate the sincere model for the three votes, using the 1980 minimum wage level for the proposals ($3.15 for Williams, $3.05 for Tower, $2.90 for Bartlett and $2.30 for the status quo). Based on the previous discussions, each Senator's desired minimum wage is assumed to be a linear function of the unemployment rate in his state, the average hourly wage in the state's manufacturing sector, the percent of the labor force which is unionized, and the Senator's party (Democrats coded one, Republican zero). Estimates of the sincere voting model for each of these votes are presented in Table 1.

TABLE 1

ESTIMATES OF EQUATION (9) FROM 1977 SENATE MINIMUM WAGE VOTES

	Bartlett	Tower	Williams
Constant	0.41 (0.18)	0.28 (0.21)	0.45 (0.23)
Unemployment	-0.05 (0.07)	-0.06 (0.06)	-0.03 (0.08)
Wage	0.22 (0.20)	0.20 (0.24)	0.25 (0.18)
Union	0.06 (0.03)	0.10 (0.04)	0.08 (0.03)
Party	1.38 (0.41)	1.24 (0.50)	1.02 (0.37)
log likelihood	-25.9	-32.8	-24.5
Hausman statistic (χ^2_5)	9.83	7.51	---
Number of observations = 85			

Asymptotic standard errors in parentheses. The Hausman statistic compares the estimated coefficients for either the Bartlett or Tower amendments to those for the Williams amendment.

The estimates in Table 1 provide no evidence of misrepresentation of preferences on the preliminary roll calls. The probabilities associated with the Hausman statistics, fall below the .05 initial values for both the Bartlett and Tower votes. (See Appendix A for details of this calculation) All three sets of estimates confirm our skepticism about the role of unemployment considerations in determining legislators' preferences on the minimum wage. Although the unemployment coefficient is negative, in all three equations its magnitude is small and the estimate is insignificant. Average wage effects are consistently positive, but also insignificant. A one dollar increase in a state's average wage increases the senator's desired minimum wage by approximately $.20. The union effect is much larger and highly significant. Others things being equal, a ten percent increase in the percentage of the workforce that is unionized, increases the desired minimum wage level by between $.60 and $1.00. The party effect is of a similar magnitude. Democrats prefer a minimum wage level between $1.02 and $1.38 higher than Republicans.

From each of these three equations, we estimated individual senator's ideal points and then the median desired minimum wage level among all 85 senators paired or voting on each amendment. The estimates of medians ranged from $3.29 to $3.57, indicating that the Williams proposal fell slightly below the median position. Using the method described in Appendix B, we found that minimum wage levels over the $4.00 level would be preferred by a majority of members to the

existing minimum wage of $2.30. This suggests that even though we cannot reject the hypothesis of sincere voting, from the broader standpoint of legislative strategy the 1977 minimum wage votes were not as uninteresting as they first appear. Although in some settings, sophisticated voting is a theoretically viable competing hypothesis to sincere voting, the formal agenda for the minimum wage decision (see Figure 4) makes it difficult to distinguish sincere and sophisticated behavior. Using the ideal points based on the estimates in Table 1, we computed the sophisticated equivalents for the agenda tree, and verified that in this situation the sincere and sophisticated outcomes were identical. Under either hypothesis (and taking the agenda as fixed), the Williams amendment emerges as the winner. Thus failure to reject sincere voting does not automatically imply rejection of sophisticated voting. A convincing test would require analyzes of situations where the agendas have different sincere and sophisticated outcomes.

The estimated ideal points are also useful for addressing questions about committee and amendment strategies. We estimated the median desired minimum wage (among the 85 senators paired or voting on each amendment). Then, using the method described in Appendix B, we found that minimum wage levels of up to about $4.00 would have been preferred by a majority of Senators to the status quo wage of $2.30. Why then did the committee's ranking members not exploit the committee's proposal power more effectively, as models of agenda setting suggest they should? The most plausible explanation is institutional. Senate floor procedures do not in general resemble the Romer and Rosenthal (1979) take-it-or-leave-it (closed rule) setting. Amendments can be and are proposed and attempts by committees to exploit their proposal power may induce amendments that bring about convergence to the median, as predicted, for example, by Black (1958) and Shepsle (1979).

The more empirically plausible follow-up question is what the committee could have achieved in the actual setting which approximated an open rule. Whereas the estimated medians ranged form $3.29 to $3.57, it seems that Williams could have succeeded with a larger increase had he desired it. (Or so, too, could proponents have successfully amended Williams upward). But the Williams amendment was not necessarily bad committee strategy for open rule settings. On the positive side, his amendment not only has the advantage of being certain to defeat the status quo, but also it left opponents of the minimum wage with only two undesirable amendment strategies. They could (and did) propose diluting amendments that were essentially destined to fail. Or alternatively (but awkwardly) they could propose "killer amendments" containing values of over $4.00, which, too, under sophisticated voting would have failed because moderates and liberals would have recognized them as such.

4. DISCUSSION AND CONCLUSIONS

The model estimated in section 3 and the test for sincere voting illustrate some possibilities for legislative roll call

analysis. Sophisticated voting is a special case of what Shepsle (1979) has called a structure-induced equilibrium. That is, our assumption of a fixed agenda could produce an outcome different from that which would follow from a different sequence of binary majority decisions. There are, of course, many other institutional features of Congress that determine how the preferences of individual congressmen are translated into legislative outcomes. Although formal analyses of institutional features at Congress are occasionally supported by anecdotal evidence, rarely are they subjected to serious empirical scrutiny. We indicate below how the basic methods described in section 2 can be used to test formal models of congressional behavior in a wide variety of situations.

One problem of considerable interest is the gatekeeping power of committees. As before, let the utility function of legislator i with measured characteristics x_i for state s_j be given by:

$$u_i(s_j) = v(x_i, s_j) + \varepsilon_{ij} \tag{14}$$

Let (X, σ) be the measure space of individual characteristics, μ be the distribution of characteristics within the chamber, and $F(\varepsilon_{ij} - \varepsilon_{ik} | x_i)$ be the conditional distribution of $(\varepsilon_{ij} - \varepsilon_{ik})$ given x_i. The key determinant to committee behavior is the so-called win set $W(s_0)$, consisting of bills that would defeat the status quo point. Because our formulation of utility is random, the win set is not deterministic, as in Shepsle's formulation. It is, however, possible to determine the probability that any particular bill will be passed by the entire chamber:

$$\text{Prob}[s_j \varepsilon W(S_0)] = P_\mu(s_j, s_0) \tag{15}$$

Some simple calculations show that this probability is given by the integral:

$$\int_X [1 - F(v(x,s_j) - v(x_1 s_0))]d\mu(x) \tag{16}$$

It follows that the expected utility of the committee reporting bill s_j to the floor for member i of the committee is given by:

$$u_i(s_j)P_\mu(s_j,s_0) + u_i(s_0)[1 - P_\mu(s_j,s_0)] \tag{17}$$

This characterizes "sophisticated" behavior of committee members and is amenable to empirical analysis using the methods described in section 2.

Of course, the example is a simplified rendering of the institutional arrangements facing congressmen. It does, however, clearly illustrate the empirical strategies that are applicable to congressional decision-making problems. Some additional areas for which theories recently have been developed but empirical tests have been limited or nonexistent include: why committees seldom get "rolled" on the floor even under open rules (Shepsle and Weingast, 1985), how jurisdictionally-induced logrolls are created and sustained (Ferejohn, 1985), why and when congressmen prefer and vote for strict applications of the new budget process (Ferejohn and Krehbiel, 1985), how "sophisticated committees" go about drafting bills to secure

passage on the floor (Denzau and Mackay, 1983), and how committees negotiate with the Rules Committee for consideration of such legislation on the floor under favorable conditions (Shepsle, 1985).

Needless to say, this is an ambitious research program, but the empirical example in section 3 gives us some encouragement about its feasibility. Subsequent work will be devoted to multidimensional choice problems where the dimensions are not so easily interpreted as in the case of minimum wage legislation. Estimation of complex models in such situations makes heavy demands on the data so success is hardly assured. While we have yet to devise tests for all of the legislative processes mentioned above, we hope to have demonstrated that formal theories of congressional behavior are not fundamentally untestable.

APPENDIX A

TESTING FOR SINCERE VOTING

Under the sincere voting model, we observe two random variables (the initial and final votes) whose distribution, under the null hypothesis of sincere voting, depends on the same parameter vector β. Since we have two estimators of this parameter (by estimating the choice model separately for each vote), this suggests a natural Hausman (1978) test comparing the two estimates.

We develop the test procedure in a slightly more general setting. Suppose y_{1i} and y_{2i} have distributions conditional on z_i, $F_1(y_{1i}|z_i,\beta)$ and $F_2(y_{2i}|z_i,\beta)$, respectively, and that the Stieltjes measures generated by $F_1(\cdot)$ and $F_2(\cdot)$ are absolutely continuous with respect to a σ-finite measure ν. The parameter vector β is assumed to belong a compact subset B of finite-dimensional Euclidean space. Let $f_1 = dF_1/d\nu$ and $f_2 = dF_2/d\nu$ denote the Radon-Nikodym derivatives of F_1 and F_2. With a random sample of size n, the maximum likelihood estimators $\hat{\beta}_{1n}$ and $\hat{\beta}_{2n}$ of β solve the following optimization problems:

$$\max_{B} \sum_{i=1}^{n} \log f_1(y_{1i}|z_i;\beta) \tag{A1}$$

$$\max_{B} \sum_{i=1}^{n} \log f_2(y_{2i}|z_i;\beta) \tag{A2}$$

Subject to some regularity conditions, both $\hat{\beta}_{1n}$ and $\hat{\beta}_{2n}$ converge to values β_1^* and β_2^*, respectively (both assumed to lie in the interior of B), as $n \to \infty$. In the terminology of Gourieroux et. al., (1983), β_1^*

and β_2^* are referred to as "pseudo true values." If the model is correctly specified (e.g., under the null hypothesis of sincere voting) then $\beta_1^* = \beta_2^* = \beta^0$ (say), so we have:

$$\hat{\beta}_{1n} \overset{a.s.}{\to} \beta^0 \tag{A3}$$

$$\hat{\beta}_{2n} \overset{a.s.}{\to} \beta^0 \tag{A4}$$

Thus, under the null hypothesis (of correct specification)

$$q_n = \hat{\beta}_{1n} - \hat{\beta}_{2n} \overset{a.s.}{\to} 0 \tag{A5}$$

The Hausman test compares q_n to zero. To compute a test statistic, we need the asymptotic covariance matrix of q_n, i.e. a sequence of matrices V_n such that:

$$n^{1/2} V_n^{-1/2} q_n \overset{D}{\to} N(0,I_p) \tag{A6}$$

In this appendix we show that:

$$\begin{aligned} V_n = {} & A_{1n}(\hat{\beta}_{1n})^{-1} B_{1n}(\hat{\beta}_{1n}) A_{1n}(\hat{\beta}_{1n})^{-1} \\ & - A_{1n}(\hat{\beta}_{1n})^{-1} C_n(\hat{\beta}_{1n},\hat{\beta}_{2n}) A_{2n}(\hat{\beta}_{2n})^{-1} \\ & - A_{2n}(\hat{\beta}_{2n})^{-1} C_n(\hat{\beta}_{1n},\hat{\beta}_{2n})' A_{1n}(\hat{\beta}_{1n})^{-1} \\ & + A_{2n}(\hat{\beta}_{2n})^{-1} B_{2n}(\hat{\beta}_{2n}) A_{2n}(\hat{\beta}_{2n})^{-1} \end{aligned} \tag{A7}$$

satisfies the condition, provided $\underset{n\to\infty}{\text{plim}}\, q_n = 0$, whether or not the model is correctly specified, where:

$$A_{jn}(\beta_j) = \frac{1}{n}\sum_{i=1}^{n} \frac{\partial^2 \log f_j(y_{ji}|z_i;\beta_j)}{\partial\beta_j\, \partial\beta_j'}$$

$$B_{jn}(\beta) = \frac{1}{n}\sum_{i=1}^{n} \frac{\partial \log f_j(y_{ji}|z_i;\beta_j)}{\partial\beta_j} \frac{\partial \log f_j(y_{ji}|z_i;\beta_j)}{\partial\beta_j'}$$

$$C_n(\beta_1,\beta_2) = \frac{1}{n}\sum_{i=1}^{n} \frac{\partial \log f_j(y_{1i}|z_i;\beta_1)}{\partial\beta_1} \frac{\partial \log f_2(y_{2i}|z_i;\beta_2)}{\partial\beta_2'}$$

We sketch the proof.

Lemma: Under the regularity assumptions of Gourieroux, Monfort, and Trognon (1984),

$$n^{-1/2}\begin{bmatrix} \sum_{i=1}^{n} \frac{\partial \log f_1(y_{1t}|z_{t1}\hat{\beta}_{1n})}{\partial\beta_1} \\ \sum_{i=1}^{n} \frac{\partial \log f_2(y_{2t}|z_t;\hat{\beta}_{2n})}{\partial\beta_2} \end{bmatrix} \xrightarrow{D} N(0,V) \quad \text{(A8)}$$

where

$$V = \begin{bmatrix} A_1(\theta_1)^{-1}B_1(\beta_1^*)A_1(\beta_1^*)^{-1} & A_1(\beta_1^*)^{-1}C(\beta_1^*,\beta_2^*)A_2(\beta_2^*)^{-1} \\ A_2(\beta^*)^{-1}C(\beta_1^*,\beta_2^*)^1 A_1(\beta_1^*)^{-1} & A_2(\beta_2^*)^{-1}B_2(\beta_2^*)A_2(\beta_2^*)^{-1} \end{bmatrix}$$

$$A_j(\beta_j) = \iint \frac{\partial^2 \log f_j(y_j|z;\beta_j)}{\partial\beta_j\, \partial\beta_j'}\, dG_j^0 d\mu$$

$$B_j(\beta_j) = \iint \frac{\partial \log f_j(y_j|z;\beta_j)}{\partial\beta_j} \frac{\partial \log f_j(y_j|z;\beta_j)}{\partial\beta_j'}\, dG_j^0 d\mu$$

$$C(\beta_j,\beta_k) = \iint \frac{\partial \log f_j(y_j|z;\beta_j)}{\partial\beta_j} \frac{\partial \log f_k(y_k|z;\beta_k)}{\partial\beta_k}\, dG^0 d\mu$$

where G_j^0 denotes the (true) conditional distributions of y_{ji} given z_i and G_j^0 the (true) joint distributions of y_{1i} and y_{2i} given z_i.

Proof: Follows from a Taylor series argument similar to White (1982) or Gouieroux, Monfort, and Trognon (1984).

Proposition: Under the null hypothesis of sincere voting:

$$n(\hat{\beta}_n - \hat{\beta}_{2n})'\, V_n^-(\hat{\beta}_{1n} - \hat{\beta}_{2n}) \xrightarrow{D} \chi_p^2 \quad \text{(A9)}$$

were $[\cdot]^-$ denotes any generalized inverse and p = rank V.

Proof: Follows from the preceding lemma and Jennrich's uniform strong law (see Rivers and Vuong, 1985, Theorem 2.9).

The test statistic in (A9) is reported in section 3 of the paper to test the sincere voting hypothesis.

APPENDIX B

ESTIMATING HYPOTHETICAL VOTE OUTCOMES

The models described in this paper posit that the probability a legislator with measured characteristics z_i votes for some bill θ_j over θ_k is given by a known function $F(z_i;\beta^0,\theta_j,\theta_k)$ which is σ_z-measurable for each combination of the last three arguments and continuous in the last three arguments for μ-almost all z_i. The true value of the parameters β^0 is unknown, but we have a consistent estimator $\hat{\beta}_n$. The problem described in the text is to estimate the expected vote for θ_j over θ_k:

$$\int F(z_i;\beta^0,\theta_j,\theta_k)d\mu \qquad \text{(B1)}$$

Let $H_n(z)$ denote the empirical distribution function of z. With the assumption of random sampling, the Glivenko-Cantelli theorem ensures that for any $E \varepsilon \sigma_z$:

$$\lim_{n\to\infty} H_n(E) \overset{a.s}{=} \mu(E) \qquad \text{(B2)}$$

By the Helly-Bray lemma:

$$\int F(z_i;\beta,\theta_j,\theta_k)dH_n \overset{a.s}{\to} \int F(z_i;\beta,\theta_j,\theta_k)d\mu$$

and the function of the right is continuous in β. It follows that the expected vote for θ_j over θ_k is consistently estimated by:

$$(1/n)\sum_{i=1}^{n} F(z_i;\hat{\beta}_n,\theta_j,\theta_k)$$

as $n \to \infty$.

This result enables us to determine sophisticated equivalents, win sets and other useful information. For example, the win set of a proposal θ_0 is defined by:

$$W(\theta_0) = \{\theta: \int F(z_i;\beta^0,\theta,\theta_0)d\mu \geq 1/2\} \qquad \text{(B3)}$$

The win set $W(\theta_0)$ can be estimated by:

$$\hat{W}_n(\theta_0) = \{\theta: (1/n)\sum_{i=1}^{n} F(z_i,\hat{\beta}_n,\theta,\theta_0) \geq 1/2\}$$

(For the case of scalar θ and single peaked preferences, $W(\theta_0)$ will be a finite interval of the real line.) Further, it can demonstrated that with probability one:

$$\lim\sup_{n\to\infty} \hat{W}_n(\theta_0) = W(\theta_0)$$

which is a set consistency concept.

FOOTNOTES

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1. For an amendment tree with n votes, the number of nodes in the associated decision tree is $\sum_{k=0}^{n-1} 2^k$.

2. For example, if employers incur training costs that increase the worker's firm-specific human capital, wage contracts rates will not reflect worker's marginal productivity. Raising the minimum wage to any level that does not exceed the worker's marginal revenue product will result in wage gains for that worker rather than dismissal. In this situation, training gives the firm a monopoly over demand for the employee's labor.

3. We also analyze a third vote on an amendment proposed by Senator Tower, even though it was not included in the UCA. We show below that even if the amendment was unanticipated, it could not have affected strategic calculations.

REFERENCES

Arnold, R. Douglas. 1979. Congress and the Bureaucracy. New Haven: Yale University Press.

Asher, Herbert B. and Weisberg, Herbert F. 1978. Voting change in Congress. American Journal of Political Science 22(May):391-425.

Bach, Stanley. 1981. Special Rules in the House of Representatives: Themes and contemporary variations. Congressional Studies 8:37-58.

Bjurulf, Bo H. and Niemi, Richard, G. 1978. Strategic voting in Scandinavian Parliaments. Scandinavian Political Studies 1:5-22.

Black, Duncan. 1958. The theory of committees and elections. London: Cambridge University Press.

Carson, Richard T. and Oppenheimer, Joe A. 1984. A method of Estimating the personal ideology of political representatives. American Political Science Review 78(March):163-78

Clausen, Aage. 1973. How congressmen decide: A policy focus. New York: St. Martin's Press.

Clausen, Aage R. and Van Horn, Carl E. 1977. How to analyze too many roll calls and related issues in dimensional analysis. Political Methodology 4:313-31.

Denzau, Arthur T., Shepsle, Kenneth A., and Riker, William H. 1985. Farquharson and Fenno: Sophisticated behavior and home style. Unpublished manuscript. Washington University: St. Louis, Missouri.

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. 1984. A new theory of congressional compromise. American Political Science Review 78:708-18.

Enelow, James M. and Koehler, David. 1980. The amendment in legislative strategy: Sophisticated voting in the U.S. Congress. Journal of Politics 42:396-413.

Farquharson, Robin. 1969. Theory of Voting. New Haven: Yale University Press.

Ferejohn, John A. 1974. Pork Barrel Politics: Rivers and Harbors Legislation, 1947-1968. Stanford: Stanford University Press.

Ferejohn, John A. 1985. Logrolling in an institutional context: A case study of food stamps legislation. Presented at the Caltech-Weingart Conference on Formal Voting Models. Pasadena, California.

Ferejohn, John A. and Krehbiel, Keith. 1985. Reconciliation and the size of the Budget. Social Science Working Paper no. 572. Pasadena: California Institute of Technology.

Gouieroux, C., Monfort, A. and Trognon, A. 1984. Pseudo maximum likelihood methods: Theory. Econometrica 52:681-701.

Hausman, J. A. 1978. Specification tests in econometics. Econometrica 46:931-959.

Heckman, James J. 1974. Shadow prices, market wages and labor supply. Econometrica 42:679-94.

Jackson, John. 1971. Statistical models of Senate roll call voting. American Political Science Review 65(June).

Jackson, John E. 1974. Constituencies and leaders in Congress. Cambridge: Harvard University Press.

Kalt, Joseph P. 1981. The economics and politics of oil price regulation. Cambridge: MIT Press.

Kalt, Joseph P. and Zupan, Mark A. 1984. The ideological behavior of legislators. Unpublished Discussion Paper. Harvard Institute of Economic Research: Cambridge, Massachusetts.

Kau, J. B. and Rubin, P. H. 1979. Self-interest, ideology, and logrolling in congressional voting. Journal of Law and Economics 22:365-84.

Keith, Robert. 1977. The use of unanimous consent in the Senate. Committees and Senate Procedures. 95th Congress: 2nd Session.

Kingdon, John. 1973. Congressmen's voting decisions. New York: Harper and Row.

Krehbiel, Keith. 1985. A rationale for restrictive rules. Manuscript.

Kingdon, John W. 1977. Models of legislative voting. Journal of Politics 39(August):563-95.

MacRae, Duncan. 1965. A method for identifying issues and factions from legislative votes. American Political Science Review 59:909-26.

MacRae, Duncan. 1958. Dimensions of congressional voting: A statistical study of the House of Representatives in the Eighty-first Congress. Berkeley: University of California Press.

Manski, Charles F. and Wise, David A. 1983. College Choice in America. Cambridge: Harvard University Press.

McFadden, Daniel L. 1981. Econometric Models of Probabilistic Choice. In C. F. Manski and D. McFadden, eds., Structural Analysis of Discrete Data with Econometric Applications. Cambridge: M.I.T. Press.

McKelvey, Richard D. and Niemi, Richard G. 1978. A multistage game representation of sophisticated voting for binary procedures. Journal of Economic Theory 18:1-22.

Morrison, Richard J. 1972. A statistical model for legislative roll call analysis. Journal of Mathematical Sociology 2:235-47.

Pashigian, B. Peter. 1982. The political economy of the clean air act: Regional self-interest in environmental legislation. Unpublished manuscript. Washington University: St. Louis, Missouri.

Peltzman, Sam. 1984. Constituent interest and congressional voting. Journal of Law and Economics 22(October):365-84.

Poole, Keith T. 1981. Dimensions of interest group evaluation of the U. S. Senate, 1969-1978. American Journal of Political Science 25(February):49-67.

Riker, William H. 1958. The paradox of voting and congressional rules for voting on amendments. American Political Science Review 52:349-66.

Rivers, Douglas and Vuong, Q. H. 1985. Lecture notes in econometric theory. Unpublished paper. California Institute of Technology: Pasadena, California.

Schneider, Jerrold E. 1979. Ideological coalitions in Congress. Westport, Connecticut: Greenwood Press.

Shepsle, Kenneth. 1979. Institutional arrangements and equilibrium in multidimensional voting models. American Journal of Political Science 23:27-59.

Shepsle, Kenneth. 1985. The positive theory of legislative institutions: An enrichment of social choice and spatial models. Presented at the Carnegie Conference on Political Economy. Pittsburgh, Pennsylvania.

Shepsle, Kenneth A. and Weingast, Barry R. 1985. The institutional foundations of committee power. Presented at the Caltech-Weingart Conference on Formal Models of Voting. Pasadena, California.

Silberberg, Eugene and Nelson, Douglas. 1984. National defense and legislative choice. Unpublished manuscript. University of Washington: Seattle, Washington.

Silberman, J. I. and Durden, G. C. 1976. Determining legislative preferences on minimum wage. Journal of Political Economy 84:317-329.

Sinclair, Barbara Deckard. 1977. Party realignment and the of the political agenda. American Political Science Review 71(September):940-53.

Smith, Steven S. 1981. The consistency and ideological structure of U.S. Senate voting alignments, 1957-1976. American Journal of Political Science 25(November):780-795.

Weisberg, Herbert F. 1978. Evaluating theories of congressional roll-call voting. American Journal of Political Science 22(August):554-75.

White, Halbert. 1982. Maximum likelihood estimation of misspecified models. Econometrica 50(January):1-26.