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IF AT FIRST YOU DON'T SUCCEED:
BUDGETING BY A SEQUENCE OF REFERENDA

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Abstract

An econometric model, based on the Romer-Rosenthal model of
agenda control by budget-maximizing bureaucracies is used to analyze
the budgetary and voting outcomes of referenda in a cross-section
of Oregon school districts. In addition to estimates of the effects
of agenda control, the model permits estimation of the spending effects
of voter failure to perceive the availability of lump-sum
intergovernmental grants. Budgets are set via referenda. In the
event of a failed referendum, a limited number of additional votes
may be taken. The model permits estimation of the degree to which
the agenda setter (e.g., the school superintendent) learns about
voter preferences from the outcomes of failed referenda.

The endogenous variables in the model are the budget proposals
and voting outcomes of each referendum in the sequence of referenda
held in each school district. The effects of proposals on voting
behavior and the effects of learning appear via structural parameters
in the error structure. The model is estimated by non-linear
maximum likelihood. The results (1) support the theoretical model
of agenda control and the effect of the setter's proposals on voting
behavior; (2) indicate that voter failure to preceive state grants
leads to important increases in spending; (3) fail to indicate any
learning by the setter.

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I. Introduction

Over a decade ago, Bradford and Oates (1971a,b) argued that the impact of intergovernmental grants must be analyzed in the context of the institutional structure of local governments. For the most part, however, econometric work in the area has either ignored local political processes,[1] or assumed that these can conveniently be collapsed into a "median voter" framework.[2] The most striking feature of the estimates of the effect of grants-in-aid is their wide variation across studies and samples. Lump-sum, non-matching grants, for example, have been estimated to increase local expenditures by much less than the amount of the grant,[3] or to have highly stimulative effects -- with spending increasing by close to the full amount of the grant.[4] (This latter finding, often dubbed the "flypaper effect", has been particularly troubling, in light of the significantly smaller effects predicted by neoclassical models of public spending.)

The institutional structure of local political processes varies widely from state to state, and may even vary across localities within a state. Modeling this variation in institutional structures may account for the wide range of estimates, as well as for the magnitude of some of the estimates. In this paper, we pursue a number of issues raised in earlier work on modeling the interaction of political and economic processes involved in local public spending decisions. The impact of outside grants in our model is intimately linked to the way these processes work.

Recent theoretical work has focused on the way the rules governing the formulation of proposals in expenditure referenda affect the results of such elections. This research places particular emphasis on the importance of agenda control by those in charge of public goods provision.[5] In the context of expenditure referenda, agenda control means restricted access to the power to make proposals that will be placed on the ballot. Acknowledging the existence of such power is in contrast to those models in which access to the agenda is unlimited.[6] In agenda control models, the preferences and actions of the group that makes proposals—the agenda setter—together with the institutional "rules of the game" become fundamentally important determinants of the outcomes.

The Agenda Control Model

Romer and Rosenthal (1979a) provided a theoretical model that deals explicitly with agenda control and its effects on the determination of collective expenditures by referendum. They consider a process in which the setter is the supplier of a collectively financed good. The setter is assumed to have preferences strictly increasing in the level of spending. Budgets (and, effectively, tax rates) are determined by simple majority vote in referenda that confront voters with a "forced choice" between the setter's proposal and an exogenous, prespecified reversion expenditure level. If the setter's proposal fails, the reversion is enacted. The reversion plays a crucial role in the process, since a sufficiently low reversion can be used as part of a threat strategy by the setter in order to extract higher spending from voters. The model identifies a

relationship between reversions and proposals as an important potential test for the presence of agenda control by budget-maximizing setters.

In some contexts, the setter may be allowed more than one attempt to pass a budget. Typically, there is a legislated limit on the number of elections that can be used to determine a given period's budget. The sequence of referenda terminates whenever a budget is approved or the limit is reached or the setter chooses to stop making proposals--whichever comes first. How the setter formulates his proposals over a sequence of referenda depends not only on the reversion but also on such factors as the setter's uncertainty about citizen preferences and voter turnout, the length of the sequence, and the possibilities the setter has for learning about the electorate from one referendum to the next. In Romer and Rosenthal (1979a), the sequence and the uncertainty facing the setter are modeled in a fairly simple way. Voters do not behave strategically. In deciding how to vote, a citizen does not take into consideration the possibility that the setter may try again if his proposal loses. Uncertainty is present due to random turnout. Citizens are assumed to vote with an exogenous and known (to the setter) probability that is independent of the proposal on the ballot and is constant over the sequence. The reversion is also fixed during the sequence of elections used to determine a given period's spending. Under these conditions, a (risk neutral) setter wishing to maximize the expected budget would plan a sequence made up of proposals that decline from one referendum to the next.

The Empirical Context

The empirical investigation of propositions emerging from this framework has focused on public school budget referenda in Oregon school

districts. The institutional structure of these elections conforms quite closely to the process analyzed by Romer and Rosenthal. Local school budgets are determined by a referendum process in which the proposals emerge from the school bureaucracy. Reversions are defined by the state constitution and are, from the point of view of a given year's budget, predetermined. In many districts, the reversion is too low to operate the schools without additional funds. Spending in excess of a district's reversion must be approved by the voters. There are provisions for holding more than one referendum in a year, but at most eight elections (depending on state law in a given year) may be called.[7] In some districts, failure to pass a referendum has resulted in the schools' being closed for several months. As the setter model would predict, this outcome is very infrequent. That it occurs at all, however, demonstrates that the setter's threat is a very real one.

Spending: The Impact of Reversions and Information

The initial emphasis of the empirical work was on the impact of reversions on expenditures.[8] Romer and Rosenthal (1982b) and Filimon et al. (1982) showed that taking reversion effects into account yields a significant improvement over the standard "median-voter" specification of a log-linear spending equation: agenda control does matter. The setter's ability to use the reversion as a threat was found to be particularly strong when the reversion is at or below the "threshold level", defined as the spending necessary to keep schools open.

While pointing to the importance of reversions, these estimates also indicated that it is not tenable to assume that either the setter or the voters act as if they have full information. On the setter's side, the

results were inconsistent with the predictions of the certainty model and suggested that setter errors due to turnout fluctuations or imperfect knowledge of voters' preferences may be important. At the same time, voters appear to be quite ignorant of resources available to the district from outside grants (i.e., state aid), and setters are able to exploit this ignorance. The lack of voter awareness of outside grants aids the setter directly (increased spending due to the grant) and through the reversion effect. (The voters perceive the reversion, which includes state aid, to be lower than it actually is.)[9]

Voting

But expenditures are only one side of the story. In studying the interaction of economic and political forces, it seems natural to consider both political as well as economic outcomes. Specifically, in a budget referendum, these correspond, respectively, to the result of the election (measured, for example, by the fraction of those voting who approved of the proposal) and the expenditure proposed to the voters. Of course, these are jointly determined. A two-equation model of voting and spending was introduced in Romer and Rosenthal (1982a). Since the present paper builds on this two-equation framework, it is useful to review it briefly.

If a budget-maximizing setter had full information about voter turnout and preferences, he would choose an expenditure proposal that made the decisive voter just indifferent between voting for the proposal and choosing the reversion. The proposal would correspond to the largest expenditure acceptable to at least half the voters. This would imply that referenda would just barely pass—the Yes vote would be very close to 50%. When the setter faces uncertainty, however, the expected voting outcome

could be different than this. A risk-neutral setter expecting random turnout may make a proposal whose expected Yes vote is not 50%; that is, the setter may "aim" for a different result. (In fact, when the setter can potentially make a sequence of proposals, he may initially even make proposals that he expects to lose. We return to this later.) If the setter makes errors in formulating his expenditure proposal, then there may be additional deviations from a 50% yes vote.

The possibility that the setter makes errors creates a link between a spending proposal and the corresponding vote result. Suppose that, based on his information about voter turnout and preferences, the setter makes a proposal that he expects to yield a% yes vote. Because his information is imperfect, however, suppose that his proposal is "too high". This positive error in setting his proposal will result in a lower than expected yes vote. Similarly, a negative error in setting the proposal will tend to raise the yes vote above a%. The two-equation model captures this dependence by including the setter's expenditure proposal error as a variable in the voting equation. Although the coefficient on this variable could not be directly estimated, the prediction that its sign is negative could be tested by estimating the covariance of the residuals from the two equations. This estimate was in fact consistent with the predicted sign, lending further support to the agenda control model.

Planning and Learning in a Sequence of Elections

Neither the single-equation expenditure models nor the two-equation model deal with considerations that arise when there is the possibility of holding more than one election to determine a given year's budget. (The expenditure equation models use data from the winning election, while the

two-equation model uses data from the year's first election.) The availability of the sequence is empirically important. In our sample of 111 Oregon school districts that held budget elections in 1971 (for the 1971-72 school year), only 69 passed proposals on the first try. Of the remaining 42 districts, 25 passed on the second try and 13 on the third, while four districts passed proposals only on the fourth attempt.

We have already pointed to one element of the setters' strategy in a sequence: plan on a series of proposals, each somewhat smaller than the one before it. In this way, the risk of losing is traded off against the opportunity to gain from a favorable turnout from high-demand voters. In the framework that led to this result, the setter's uncertainty was due entirely to random turnout fluctuations. The results of a losing election in a sequence provided no new information to be used in determining the next proposal. There is no link, therefore between the vote outcome in one election and the proposal in the next election.

Suppose, however, that the setter had some uncertainty about voter preferences, as well as turnout. Then the observation of the vote on a first election loss may provide the setter with some information about his "expenditure error". (As in the two-equation model, there would be a negative relationship between this error and the voter outcome.) He may then use this information to adjust his proposal for the second equation, relative to what it would have been otherwise. This updating would create a link between the vote in the first election and the spending proposal in the second election. The updating would continue after each failed proposal.

In the next section of this paper we develop an econometric specification of a setter model of referenda with a sequence of

elections. The model has six equations--an expenditure equation and a vote equation for each of the first three elections—that are linked through the model's error structure. The expenditure equations incorporate the reversion effects as well as imperfect information by setter and voters. The voting equations include parameters that reflect the setter's errors in making proposals. We stopped at the third election because there are too few four election observations (4) for estimation of a four election model. Section 3 presents the results of our estimates of this model.

2. Spending and Voting in a Sequence

The Spending Equation

The core of our model is the expenditure equation developed in Filimon et al. (1982). This equation incorporates an estimate of voter preferences, the effect of reversions, and the possibility of voter ignorance of state aid. We modify this specification to capture errors made by the setter and to take into account the sequence of proposals.

The basis of the setter's proposals is the distribution of the largest expenditure acceptable to voters in his district, given the district's reversion, together with an estimate of turnout probabilities. If there were only one election, this information would generate an expenditure proposal that we assume is adequately approximated by:

$$\ln \bar{E}_p = \ln \bar{E}_d + \theta_1 \bar{H} + \theta_2 \ln \bar{Z} + u + e' \tag{1}$$

In this specification, the variables with overbars represent _perceived_, rather than actual quantities, to reflect the voter's possible lack of information about outside grants. Thus, $\bar{E}_p$ is the perceived budget proposal, measured in dollars per student. $\bar{E}_d$ is the underlying demand for perceived expenditures (per student) of a "representative" voter, in the absence of reversion considerations. The variables $\bar{H}$ and $\bar{Z}$ depend on the reversion as perceived by this voter. The error terms u and e' reflect errors by the setter and by the modeler, respectively.

Demand

We characterize the "representative" demand for perceived expenditures by using a log-linear specification that is standard in the literature:

$$\ln \bar{E}_d = \beta_0 + \beta_1 \ln \bar{Y} + \beta_2 \ln P + \beta_3 \ln S + e'' \tag{2}$$

where

$\bar{Y}$ is perceived household income

P is tax price faced by the household

S is number of students in household

e'' is an error term

Agenda Control Effects

The reversion variables are defined as follows:

$$\bar{H} = \begin{cases} 1 & \text{if } \bar{Q} \leq \mu \\ 0 & \text{if } \bar{Q} > \mu \end{cases}$$

$$\bar{Z} = \begin{cases} \mu & \text{if } \bar{Q} \leq \mu \\ \bar{Q} & \text{if } \bar{Q} > \mu \end{cases}$$

$\bar{Q}$ is the perceived reversion per student. The parameter μ, which is to be estimated, is a nonnegative constant corresponding to the "threat threshold". If the reversion is below this threshold, the reversion is insufficient to operate the schools. Consequently, for reversions at or below μ, the setter's threat position vis-à-vis the voters is stronger than for higher reversions. Moreover, this threat is equally strong for any reversion perceived by the voters to be below the threshold. Equation

(1) characterizes this relationship by positing that, ceteris paribus,
proposed spending is constant for $\bar{Q} < \mu$. When the perceived reversion is
above the threshold, proposed spending is taken to be a loglinear function
of the reversion. The threshold effect implies $\theta_1 > 0$. With uncertain
voter turnout, Romer and Rosenthal (1979a) suggest that the sign of θ_2 is
ambiguous.

Voter Perception and State Aid

Actual and perceived quantities may differ because of misperception
by voters of state aid available to the local school district.[10] This aid
was in the form of lump-sum per-student grants. If A is the amount of the
grant per student, we let $(1-\rho)A$ be the amount perceived per student,
where ρ is a parameter to be estimated and is assumed equal across school
districts. The perceived quantities are then defined as:

$$\bar{E}_p = E_\ell + (1-\rho)A \tag{3}$$

$$\bar{Y} = Y + (1-\rho)rA \tag{4}$$

$$\bar{Q} = Q_\ell + (1-\rho)A \tag{5}$$

E_ℓ is the proposed expenditure to be financed out of local taxes. Y is
the "representative" household's income and r is this household's tax
share. Q_ℓ is the local portion of the reversion. In Oregon, it is
composed of a lump-sum intermediate district payment and an amount
specified by the state constitution. If the local expenditure proposal
passes, total spending per student is:

$$E = E_\ell + A$$

State aid affects local spending through three channels:

— Individual incomes: Perceived state aid affects perceived income,
through (4), and hence demand for local spending. This is the income
effect typically captured in standard models of public spending (with $\rho=0$).

— "Flypaper": State aid can be added on to spending from local
sources. If the aid is not fully perceived by voters, perceived total
spending can differ from actual; if $\rho>0$, then $\bar{E}_p < E$. This is a
"flypaper" type of effect: the greater ρ, the stickier the "flypaper".

— Reversion and threshold: State aid forms part of the district's
reversion. Even if state aid is correctly perceived by voters ($\rho=0$), this
reversion effect would cause the impact of aid on spending to differ from
the impact of the income effect alone. [Romer and Rosenthal (1980).] For
relatively low reversions, the setter benefits from imperfect perception
of state aid. If $\rho>0$, the perceived reversion is less than the actual
reversion, increasing the setter's threat position vis-à-vis the voters
(relative to $\rho=0$). This effect is enhanced for districts whose actual
reversion $(Q_\ell+A)$ is above the shut-down threshold μ, but whose perceived
reversion $\bar{Q}$ is below the threshold.

On the whole, the "flypaper" and "reversion" effects are likely to
outweigh the income effect, so that the setter will typically benefit from
higher values of ρ. [See Filimon et al. (1982).]

Expenditures with a Single Election

Substituting (2) into (1) gives the specification for a
single-election expenditure equation:

$$\ln \bar{E}_p = \beta_0 + \beta_1 \ln \bar{Y} + \beta_2 \ln P + \beta_3 \ln S + \theta_1 \bar{H} + \theta_2 \ln \bar{Z} + u + e$$

The errors e' and e" are errors in specifying the reversion effect and the underlying demand, respectively. We assume that across observations they each have i.i.d. normal distributions with zero mean. They cannot be separately identified, so we write them as e = e' + e". The setter's error u is due to the setter's lack of information about turnout and voter preferences. Since the setter does not make the errors captured by e, we will call e the econometrician's error (even though this is a mild misnomer, in that the econometrician also makes the error u).

Spending Proposals in a Sequence

To place the process in the context of a sequence, we redefine variables slightly, to distinguish between various elections. We let $\bar{E}_1$ be the perceived proposal on the first, $\bar{E}_2$ the perceived proposal on the second, and $\bar{E}_3$ the perceived proposal on the third election. Then

$$\ln \bar{E}_1 = \beta_{01} + X\beta + \theta_1 \bar{H} + \theta_2 \ln \bar{Z} + u_1 + e_1 \tag{6}$$

$$\ln \bar{E}_2 = \beta_{02} + X\beta + \theta_1 \bar{H} + \theta_2 \ln \bar{Z} + u_1 + e_1$$
$$+ \text{(learning update)} + e_2 \tag{7}$$

$$\ln \bar{E}_3 = \beta_{03} + X\beta + \theta_1 \bar{H} + \theta_2 \ln \bar{Z} + u_1 + e_1 + e_2$$
$$+ \text{(second learning update)} + e_3 \tag{8}$$

The expression $X\beta$ is shorthand for the RHS of (2), minus the intercept and the error term e".

Equation (7) and (8) differ from (6) only through the error structure and the constant term. To motivate the latter difference, we first note

that, by law, the reversion in a district is the same for each election in a sequence. Furthermore, we assume that voters are randomly drawn from the same population in each election and that voters do not behave strategically. Then the model presented in Romer and Rosenthal (1979a) leads, in the absence of learning by the setter, to the hypothesis of a sequence of declining proposals. Given our relatively small sample of districts with multiple elections, we allowed only the constant to change across elections, and predicted $\beta_{01} > \beta_{02} > \beta_{03}$.

As to the error structure, the econometrician makes additional errors e_2 and e_3 in the second and third elections. These errors pertain to specification of the learning update. The setter's error in (7) and (8) consists of his error on the first proposal, u_1, modified by whatever adjustment he makes by learning. If the outcome of the first election yields information that the setter uses to update what would otherwise have been his second proposal, then the second expenditure equation should incorporate this updating. Similar considerations apply on the third attempt. In order to discuss the specification of setter learning, we must deal with the voting equations.

The Voting Equations

The voting variable we will be concerned with is the vote logit V, defined as

$$V = \ln \left[\frac{\text{Number of Yes Votes}}{\text{Number of No Votes}} \right]$$

A fundamental simplifying assumption concerning voter turnout (i.e., the fraction of the electorate that votes) is that it is unrelated to the

reversion or the setter's proposal. A risk-neutral setter maximizing the expected budget under perfect knowledge of voter preferences and turnout probabilities would generally choose a sequence of proposals such that the corresponding expected vote logit would differ from zero (i.e., the expected yes vote is other than 50%). Let the expected vote logit for such a setter on the tth election be α_t (t=1,2,3). The analysis of sequences in Romer and Rosenthal (1979a) suggests that $\alpha_3 > \alpha_2 > \alpha_1$. Of course, actual logit values would differ according to turnout fluctuations.

If the setter makes errors due to his misperceptions of voter preferences or turnout probabilities, the vote outcome should reflect this error. As we discussed in the Introduction, there should be a negative relationship between the setter's error in his proposal and the vote logit. A proposal that is too large (relative to a zero-error proposal) will lead to an expected logit less than α_t, while a proposal that is too small will drive the expected logit above α_t.

In combining these effects, we have the voting equations

$$V_t = \alpha_t + \delta u_t + v_t, \quad t=1,2,3 \tag{9}$$

The subscripts refer to election numbers. The errors v_t reflect specification errors or other factors independent of the expenditure equations. (We will assume that v_1, v_2, and v_3 are uncorrelated and have identical normal distribution with zero mean.) The parameter δ, whose sign is predicted to be _negative_, is a straightforward (and admittedly crude) characterization of the way setter errors are translated into vote outcomes. We assume that this relationship is the same in all elections.

Less defensibly, we also assume that the parameters α_t and δ are constant across school districts.[11]

Learning: A Heuristic Representation

Using equation (9), we can develop a heuristic approximation to represent learning by the setter. A given proposal $\bar{E}_t$, with no setter error, is expected to lead to a logit of α_t. How the setter responds to a particular vote outcome V_t will depend on his assessment of the relative importance of the error term v_t. We assume that the setter knows both δ and the variance of every error. Since v_t has zero mean, if its variance is also known to be very close to zero, then the deviation $V_t - \alpha_t$ must be due nearly entirely to the setter's error. In this case, it seems reasonable for the setter to adjust his next proposal by $-(V_t - \alpha_t)/\delta$, relative to what would otherwise have been his optimal proposal on that election. (In other words, if $V_1 < \alpha_1$, this means cutting back the second proposal—recall that $\delta < 0$.)

When the variance of v_t is large, relative to the variance of the setter's error, then the deviation $V_t - \alpha_t$ does not provide very much information. In this case, the adjustment of the next proposal should be at best a fraction of $-(V_t - \alpha_t)/\delta$. For example, if the variance of v_1 is positive while that of u_1 is very close to zero, then nearly the entire deviation $V_1 - \alpha_1$ must be due to factors other than setter's error. Consequently, little or no adjustment of the second proposal is called for on the basis of information obtained from the first election outcome.

A simple way to incorporate this kind of updating into the second and third expenditure equations is to include a term $-s(V_t - \alpha_t)/\delta$, where the

parameter s ($0 \leq s \leq 1$) represents the adjustment factor. We will assume that this parameter is the same across all jurisdictions.

Including this "learning update" term in (7) and (8), we can rewrite the second and third expenditure equations as:

$$\ln \bar{E}_2 = \beta_{02} + X\beta + \theta_1\bar{H} + \theta_2\ln \bar{Z} - s(V_1-\alpha_1)/\delta + u_1 + e_1 + e_2 \quad (10)$$

$$\ln \bar{E}_3 = \beta_{03} + X\beta + \theta_1\bar{H} + \theta_2\ln \bar{Z} - s(V_2-\alpha_2)/\delta + u_2 + e_1 + e_2 + e_3 \quad (10')$$

Since

$$(V_t-\alpha_t)/\delta = u_t + v_t/\delta,$$

the setter's errors in (10) and (10') become

$$u_2 = (1-s)u_1 - sv_1/\delta$$

$$u_3 = (1-s)u_2 - sv_2/\delta = (1-s)^2 u_1 - s(1-s)v_1/\delta - sv_2/\delta$$

The whole system can then be rewritten as:

$$\ln \bar{E}_1 = \beta_{01} + X\beta + \theta_1\bar{H} + \theta_2\ln \bar{Z} + u_1 + e_1 \quad (11a)$$

$$V_1 = \alpha_1 + \delta u_1 + v_1 \quad (12a)$$

$$\ln \bar{E}_2 = \beta_{02} + X\beta + \theta_1\bar{H} + \theta_2\ln \bar{Z} + (1-s)u_1 - sv_1/\delta + e_1 + e_2 \quad (11b)$$

$$V_2 = \alpha_2 + \delta(1-s)u_1 - sv_1 + v_2 \quad (12b)$$

$$\ln \bar{E}_3 = \beta_{03} + X\beta + \theta_1\bar{H} + \theta_2\ln \bar{Z} + (1-s)^2 u_1$$
$$\qquad - s(1-s)v_1/\delta - sv_2/\delta + e_1 + e_2 + e_3 \quad (11c)$$

$$V_3 = \alpha_3 + \delta(1-s)^2 u_1 - s(1-s)v_1 - s\, v_2 + v_3 \quad (12c)$$

The errors u_1, e_t, and v_t are assumed to have the following structure. A given error is assumed to be uncorrelated across school districts and have, in each district, the same normal distribution with zero mean. The error variances are:

$$Var(u_1) = \sigma_u^2 \qquad\qquad Var(v_1) = Var(v_2) = Var(v_3) = \sigma_v^2$$

$$Var(e_1) = \tau_1^2 \qquad\qquad Var(e_2) = \tau_2^2 \qquad\qquad Var(e_3) = \tau_3^2$$

Furthermore, the econometrician's errors e_t are uncorrelated with each other or with any other disturbance term. Because turnout is independent of the setter's proposal, the setter's error u_1 is uncorrelated with the voting equation errors v_t. We assume that turnout does not depend on the outcome of elections, so that the v_t are also uncorrelated.

In specifying the model, we had to trade off generality against the estimation problems posed by the small number of observations with second or third elections. We decided to allow proposals to change only through the intercepts and the learning update. We did not allow for temporal variation in σ_v^2. We have three econometrician's error variances, τ_t^2. The model is not identified unless we assume the econometrician errs in modelling the updates as well as in modelling the initial proposal.

3. Estimation and Results

The income, tax-price, and students per household variables that appear in the expenditure equation were computed as follows. Income, Y, is median family income adjusted for school bond and other prior school tax commitments. Tax price, P, per dollar of per student spending was measured as tax share multiplied by enrollment in the school district. In turn, we computed tax share as the ratio of median housing value to total assessed valuation. As a measure of the number of students in the voter's household, S, we used the ratio of total school enrollment to the number of families.[12] Data on basic variables appear in Table 1.

The threshold effect associated with the reversion variables creates a discontinuity in equations (11) when the perceived reversion equals the threshold parameter μ. In order to make the likelihood function and its partial derivatives continuous, we used a technique developed by Tishler and Zang (1979). This involves approximating the discontinuous variable $\bar{H}$ and the variable $\bar{Z}$ (whose first derivative is discontinuous) by twice continuously differentiable polynomials whenever the perceived reversion falls in an interval within $\pm\gamma$ of the threshold; γ is a prespecified positive constant.[13] In the estimates that we report here, we have set $\gamma=2.0$, less than 1% of the estimated threshold.

The error structure of the system (11)-(12) is also used in the estimation. We let σ_{11} be the error variance of the first expenditure equation, σ_{22} that of the first voting equation, σ_{33} of the second expenditure equation, and σ_{44} of the second voting equation, etc. Similarly, σ_{12} is the covariance between the first expenditure equation and the first voting equation, etc. The variances and covariances of the

error structure in equations (11)-(12) can then be expressed in terms of the individual error variances and the structural parameters s and δ.

$$\sigma_{11} = \sigma_u^2 + \tau_1^2 \tag{13}$$

$$\sigma_{22} = \delta^2\sigma_u^2 + \sigma_v^2 \tag{14}$$

$$\sigma_{33} = (1-s)^2\sigma_u^2 + \tau_1^2 + \tau_2^2 + (s^2/\delta^2)\sigma_v^2 \tag{15}$$

$$\sigma_{44} = \delta^2(1-s)^2\sigma_u^2 + (1+s^2)\sigma_v^2 \tag{16}$$

$$\sigma_{55} = \tau_1^2 + \tau_2^2 + \tau_3^2 + (1-s)^4\sigma_u^2 + [(1-s)^2+1](s^2/\delta^2)\sigma_v^2 \tag{17}$$

$$\sigma_{66} = \delta^2(1-s)^4\sigma_u^2 + [s^2(1-s)^2+s^2+1]\sigma_v^2 \tag{18}$$

$$\sigma_{12} = \delta\sigma_u^2 \tag{19}$$

$$\sigma_{13} = \tau_1^2 + (1-s)\sigma_u^2 \tag{20}$$

$$\sigma_{14} = \delta(1-s)\sigma_u^2 \tag{21}$$

$$\sigma_{15} = \tau_1^2 + (1-s)^2\sigma_u^2 \tag{22}$$

$$\sigma_{16} = \delta(1-s)^2\sigma_u^2 \tag{23}$$

$$\sigma_{23} = \delta(1-s)\sigma_u^2 - (s/\delta)\sigma_v^2 \tag{24}$$

$$\sigma_{24} = \delta^2(1-s)\sigma_u^2 - s\sigma_v^2 \tag{25}$$

$$\sigma_{25} = \delta(1-s)^2\sigma_u^2 - (s/\delta)(1-s)\sigma_v^2 \tag{26}$$

$$\sigma_{26} = \delta^2(1-s)^2\sigma_u^2 - s(1-s)\sigma_v^2 \tag{27}$$

$$\sigma_{34} = \delta(1-s)^2\sigma_u^2 + (s^2/\delta)\sigma_v^2 \tag{28}$$

$$\sigma_{35} = \tau_1^2 + \tau_2^2 + (1-s)^3\sigma_u^2 + (s^2/\delta^2)(1-s)\sigma_v^2 \tag{29}$$

$$\sigma_{36} = \delta(1-s)^3\sigma_u^2 + (s^2/\delta)(1-s)\sigma_v^2 \tag{30}$$

$$\sigma_{45} = \delta(1-s)^3\sigma_u^2 + (s/\delta)[s(1-s)-1]\sigma_v^2 \tag{31}$$

$$\sigma_{46} = \delta^2(1-s)^3\sigma_u^2 + s[s(1-s)-1]\sigma_v^2 \tag{32}$$

$$\sigma_{56} = \delta(1-s)^4\sigma_u^2 + (s^2/\delta)[(1-s)^2 + 1]\sigma_v^2 \tag{33}$$

These twenty-one equations in the seven parameters s, δ, τ_1^2, τ_2^2, τ_3^2, σ_u^2, and σ_v^2 yield an overidentified system. In estimating (11)-(12) by

full information maximum likelihood methods, however, we can incorporate the overidentifying restrictions (13)-(33). In this way, the estimated parameters will be the set that minimizes the variance-covariance matrix of the estimated standard errors of these parameters. The maximum likelihood procedure recognizes that some observations have no second or third elections. In the Appendix, we provide some details about the derivation of the likelihood function.

Results of the maximum likelihood estimation are presented in Table 2. To indicate the stability of most parameters, we present estimates for the case where just the first election data are used, then the first two elections, and finally the first three elections. In all three cases, the coefficients on income (β_1), tax price (β_2), and number of students in the household (β_3), and their estimated standard errors are very close to the estimates from the single-equation expenditure model of Filimon et al. (1982). The same is true of the reversion coefficients θ_1 and θ_2, the threshold μ, and the perception parameter ρ. The impact of reversions and of voter misperception of outside grants is undiminished in the fuller system.

Perception and State Aid

The estimated perception parameter ρ is 0.97. While we readily reject the null hypothesis of complete information ($\rho=0.0$), we fail to reject the hypothesis that voters act as if there were no state aid ($\rho=1.0$). Thus, a dollar of state grant leads to a dollar of additional expenditure, with no reduction in local taxes. Using $\rho=1$, the direct proportional effect of aid on per student spending is $A/(E-A)$. From Table 1, for first elections, at the sample means this is $A/(E-A) =$

TABLE 1
DESCRIPTION OF VARIABLES

		Mean	Standard Deviation
E_1:	proposed total expenditure per student, first election, 1971-72 (dollars),		
	all districts	957.09	180.36
	districts failing first election	984.60	188.80
E_2:	proposed total expenditure per student, second election, 1971-72	972.51	194.05
	districts failing second election	952.51	181.86
E_3:	proposed total expenditure per student, third election, 1971-72	949.09	181.36
Y:	median family income, adjusted for local school bond taxes and intermediate education district taxes and receipts (dollars)	9341.03	1320.18
R:	true cash value of all taxable real estate in district (dollars)	100,337,000	139,489,000
K:	median housing value (dollars)	13,411.20	3291.61
D:	total students, measured by average daily membership	2591.52	3602.58
P:	tax price = DK/R (dollars)	0.378	0.151
A:	(lump sum) state aid per student from the Basic School Support Fund (dollars)	228.54	57.40
Q_ℓ:	local reversion per student (dollars)	258.01	150.60
S:	Students per family	0.973	0.203
V_1:	vote logit, first election*	0.140	0.369
V_2:	vote logit, second election*	0.073	0.300
V_3:	vote logit, third election*	0.030	0.143

*Antilogit of mean V_1 = 53.49%. Antilogits of $\pm$ one standard deviation: 44.29% and 62.46%.
Antilogit of mean V_2 = 51.81%. Antilogits of $\pm$ one standard deviation: 44.33% and 59.22%.
Antilogit of mean V_3 = 50.75%. Antilogits of $\pm$ one standard deviation: 47.20% and 54.31%.
[The antilogit of V is given by $1/(1+e^{-V})$.]
Number of observations in sample: 111. [42 districts had two elections, 17 districts had three.]

228.54/(957.09 - 228.54) = 0.31, and for second elections it is 228.54/(952.51 - 228.54) = 0.32. The presence of state aid increased proposed expenditures by roughly 30 percent.

Proposed expenditures are raised another $100(e^{\theta_1}-1) = 14.3\%$ for those districts with reversions just below the threshold of $211 relative to those districts just above the threshold. Full perception of state aid, whose mean of $228.54 exceeds the threshold, would put nearly all observations above the threshold. Thus, voters' failure to perceive state aid may not only increase proposals by 30% due to direct perception effects, but, in a substantial number of districts, also by another 14.3% due to reversion effects.

We would also expect these effects to work in reverse, at least at the margin. The magnitudes of our estimates suggest that a _cutback_ in state aid would not be offset, even partially, by local spending on public education.

Learning and Adjustment

The expenditure intercept terms β_{01}, β_{02}, and β_{03} have almost identical estimates, with large standard errors. This suggests that the underlying pattern of a sequence of decreasing proposals of the type suggested by Romer and Rosenthal (1979a) is not important.

The "learning update" parameter s is estimated at 0.222, with a standard error equal to this estimate. As might be expected, s is the parameter whose estimate is most affected by using the data from all three, as against only the first two, elections. The estimate is in the theoretically predicted range of [0,1] both times. In both cases, it is

small relative to its standard error, but with the additional data the estimate equals its standard error whereas it is only one-half the standard error in the two-election case. This suggests that our failure to find substantial updating may relate to the small effective sample size with multiple elections.

Even with more data, however, we would be unlikely to discover an effect of appreciable importance. Setters do not appear to adjust proposals in light of election outcomes in the heuristic manner that we postulated.[14] Based on the expenditure equation estimates, it seems that the first spending proposal is also an excellent prediction of the second proposal in those districts where the first election fails. The data appear to bear this out. Of the 42 districts in which there was a second election, 16 first-election proposals were not changed and three were increased (by less than 3%). Of the remaining 23 districts where the first proposal was defeated, only 10 saw cuts by more than 2% between the first election and the second. The average differences in proposals ($949 vs. $953) between the second and third elections was even less than the difference between the first two ($985 vs. $973).

In contrast to the absence of significant updating, the setter's error influences vote outcomes as we expected. The sign of δ is negative: a proposal that is "too large" drives the vote logit below the "error-free" expected value. To get a feel for the effect of the setter's error on voting, we computed the impact that a $50 per student "error" would have in an "average" district. From Table 1, using statewide mean values and our estimate of $\rho=0.975$, an "average" first election perceived expenditure is $957.09 - 0.975 \times 228.54 = 734.26$. For a $50 error in perceived spending per student, u_1 is given by:

TABLE 2
MAXIMUM LIKELIHOOD ESTIMATES

Structural Parameters	One Election Estimates		Two Election Estimates		Three Election Estimates	
	Estimate	Estimated Standard Error	Estimate	Estimated Standard Error	Estimate	Estimated Standard Error
β_{01}	-2.015	1.683	-1.947	1.720	-1.900	1.767
β_{02}			-1.961	1.723	-1.905	1.770
β_{03}					-1.918	1.772
β_1	0.775	0.180	0.768	0.185	0.762	0.189
β_2	-0.362	0.054	-0.364	0.054	-0.367	0.052
β_3	-0.242	0.078	-0.240	0.080	-0.242	0.082
θ_1	0.136	0.047	0.135	0.047	0.134	0.047
θ_2	0.186	0.085	0.185	0.085	0.186	0.087
ρ	0.972	0.196	0.974	0.202	0.975	0.202
μ	211.80	37.36	211.51	38.50	211.34	38.53
α_1	0.140	0.040	0.140	0.043	0.140	0.044
α_2			0.297	0.090	0.224	0.098
α_3					0.396	0.174
δ			-7.207	3.431	-5.378	2.001
s			0.092	0.193	0.222	0.223
Error Variances*						
τ_1^2			0.026	0.0055	0.025	~0.0055
τ_2^2			0.0012	0.00026	0.0012	0.00028
τ_3^2					0.00065	0.00053
σ_u^2			0.0020	0.0020	0.0032	0.0024
σ_v^2			0.036	0.010	0.047	0.013
Ln of likelihood function	-731.12		-929.212		-1006.638	

*The parameters δ, τ_1^2, σ_u^2, and σ_v^2 are not identified in single election estimates. The reduced form estimates (and estimated standard errors) are: σ_{11}, 0.0273(0.0057); σ_{22}, 0.136(0.018); σ_{12}, -0.0125(0.0069).

$u_1 = \ln(784.26) - \ln(734.26) = 0.066$.

If $v_1 = 0$, the effect of a setter's error of this magnitude on the first election outcome is:

$$V_1 = \alpha_1 + \delta u_1 = -0.215,$$

which corresponds to a 44.6% Yes vote, as contrasted with the 53.5% Yes vote (implied by $\alpha_1 = 0.140$) that would be expected with $u_1 = 0$. On the second election, the effect of the error, adjusted by our point estimate of the learning update, can be calculated by setting v_2 also equal to zero, so that

$$V_2 = \alpha_2 + \delta(1-s)u_1 = -0.051,$$

which corresponds to a 48.7% Yes vote, rather than the 55.6% Yes vote (corresponding to $\alpha_2 = 0.224$) that would be implied by complete updating (s=1).

For the third election, a similar calculation shows

$$V_3 = \alpha_3 + \delta(1-s)^2 u_1 = 0.182,$$

which corresponds to a 54.6% Yes vote, rather than the 59.8% vote (corresponding to $\alpha_3 = 0.396$) implied by complete updating. Comparing the estimates of the voting equation intercepts, α_t, suggests that the expected vote logit on each later election is greater than that on the

preceding election. This would be consistent with the kind of sequence derived in Romer and Rosenthal (1979a). Yet, as we have seen, the expenditure equation estimates do not reveal a strong sequence effect. Given the data at our disposal, we cannot be definite about the net effect of the underlying sequence structure.

Some reconciliation of the results may be suggested by comparing the effect of the setter's error in the voting and the expenditure equations. In the second election voting equation, the total error variance is equal to $\delta^2 \sigma_u^2 = 0.0926$ plus $\sigma_v^2 = 0.0469$. Thus, because of the substantial magnitude of δ, errors by the setter are estimated to have twice the effect of the random turnout component on voting behavior. In contrast, most of the variance of the first expenditure equation is ascribed to the econometrician's inability to capture the purely static feature of demand, since $\tau_1^2 = 0.025$ is nearly eight times the estimated setter error variance, $\sigma_u^2 = 0.0032$. The "noise" in the static model may make it difficult to discuss the sequence effects. In any event, we estimate that setters do not make substantial errors[15] (at the mean first election proposal of \$957.09, setter errors of $\pm\sigma_u = .0566$ would result in proposals of \$917 and \$1000), a result in line with our basic premise that setters actively pursue a goal of budget-maximization.

Another clue to these results may lie in the findings of Rubinfeld (1977), who used survey data on individuals to analyze voting in a Michigan school district. There were two elections to pass a budget. The first one lost, but the second proposal—identical to the first—passed, with increased voter turnout. The critical difference in the second election appears to have been greater participation by women with school-age children who tended to vote for the proposal. A plausible

interpretation is that the first election loss ·influenced the turnout on the second election, particularly by those who were particularly threatened by a possible shutdown of the schools.

Carrying this over to our results suggests that setters are aware that turnout is likely to increase on later elections. (Indeed, Romer and Rosenthal (1982c) have shown, for a much larger sample, that turnout is systematically larger on the passing election than on the first election.) Moreover, setters may be expecting relatively higher turnout by groups favoring the proposal. And voters may even change positions on the proposal. Our sample contains observations where the absolute number of No votes falls even when turnout increases substantially, hinting that some voters who initally vote No may change their votes as the closing of the schools becomes a more imminent possibility. These factors counteract the considerations for cutting the proposal, but are still consistent with expecting a higher Yes vote on a later election even if the proposal is unchanged. The parameters α_2 and α_3 may be capturing this expectation. At the same time, the setter's failure to correct his initial error may be working against the full realization of a Yes vote consistent with α_2 or α_3. If $u_1 > 0$ in districts with a first election loss, then this effect is negative, particularly if s is close to zero. Consequently, second and third election outcomes (whose sample means are 51.8% and 50.8%, respectively) may be much closer than the Yes vote implied by α_2 (approximately 56%) or α_3 (60%).

Conclusion

This research has largely confirmed the agenda setter model's ability to account for the static properties of cross-sectional spending and

voting in Oregon. Estimates of the demand parameters (β), reversion parameters (θ and μ), and perception parameter (ρ) are unaffected by sequence effects. The number of elections needed for passage and voting in a given election both appear largely determined by the interaction of the setter's error (σ_u^2) and "random" effects on voting (σ_v^2). If we group the districts by whether one, two, or more than two elections were required to pass, we find that group means of both the exogenous and endogenous variables vary little in comparison to the within-group standard deviations. Earlier research (Romer and Rosenthal, 1982a) showed that the exogenous variables have no direct ability to explain the vote logits. The only systematic effect on voting is the setter's behavior. The parameter δ is negative as predicted, and the estimate is 2.7 times its standard error.

We have not dealt successfully with the dynamics. The insignificant variation in the β_{0t} and the insignificant value of s leave us with no evidence for either a pre-planned decreasing sequence of proposals (Romer and Rosenthal, 1979a) or heuristic learning.

Most work in the political economy of public finance, including ours, assumes constant indirect preferences for spending and either constant or random turnout. Our results make these assumptions less attractive. Finding the α_t consistent with the model even in the absence of significant β_{0t} or s suggests that turnout and preferences may vary systematically in a dynamic context.

APPENDIX

We rewrite the system (11)-(12) in matrix notation. We define $\underline{C}_t$ to equal $\ln \underline{E}_t$ (t=1,2,3), and use $\underline{X}$ to summarize the exogenous variables. We implicitly include the nonlinear parameters in $\underline{C}$ and $\underline{X}$:

$$\underline{C}_t = \underline{X}\underline{\beta}_t + \underline{\epsilon}_{1t} \tag{A1}$$

$$\underline{V}_t = \underline{1}\alpha_t + \underline{\epsilon}_{2t} \tag{A2}$$

where

$$\underline{\epsilon}_{11} = \underline{u}_1 + \underline{e}_1$$

$$\underline{\epsilon}_{21} = \delta\underline{u}_1 + \underline{v}_1$$

$$\underline{\epsilon}_{12} = (1-s)\underline{u}_1 - (s/\delta)\underline{v}_1 + \underline{e}_1 + \underline{e}_2$$

$$\underline{\epsilon}_{22} = \delta(1-s)\underline{u}_1 - s\underline{v}_1 + \underline{v}_2$$

$$\underline{\epsilon}_{13} = (1-s)^2\underline{u}_1 - (s/\delta)(1-s)\underline{v}_1 - (s/\delta)\underline{v}_2 + \underline{e}_1 + \underline{e}_2 + \underline{e}_3$$

$$\underline{\epsilon}_{23} = \delta(1-s)^2\underline{u}_1 - s(1-s)\underline{v}_1 - s\underline{v}_2 + \underline{v}_3$$

We need to distinguish between the three sub-samples of school districts: the first set consisting of districts that held three elections, the second set consisting of districts where the second election passed and the third where the first election passed. We number school districts $1,\ldots,n_3,\ldots,n_2+n_3,\ldots,N$. The first n_3 school districts have three elections, the next n_2 districts pass on the second election, while the last $n_1=N-n_2-n_3$ school districts get their budgets approved in the first election. We assume there is no correlation across school districts. We wish to derive the probability of observing a given sample.

Consider a school district j, where the expenditure is approved in the first election. The probability of this happening is $Pr(V_{j1} \geq 0)$. The joint probability of observing the given expenditure, the vote, and termination of the election process can be expressed as:

$$f(\epsilon_{j11},\epsilon_{j21}) \, Pr(V_{j1} \geq 0 \mid \epsilon_{j11},\epsilon_{j21}) =$$
$$f(\epsilon_{j11},\epsilon_{j21}) \, Pr(\epsilon_{j21} \geq -\alpha_1 \mid \epsilon_{j11},\epsilon_{j21}),$$

where $f(\epsilon_{j11}, \epsilon_{j21})$ is the joint density function of $\epsilon_{j11}, \epsilon_{j21}$. Notice that $Pr(\epsilon_{j21} \geq -\alpha_1 \mid \epsilon_{j11}, \epsilon_{j21})$ is either 0 or 1 and hence need not appear in the likelihood function.

Therefore the probability of observing the sample of n_1 school districts [suppressing the term $Pr(\epsilon_{j21} \geq -\alpha_1 \mid \epsilon_{j11}, \epsilon_{j21})$] where the budget is passed on the first election is given by:

$$\prod_{j=n_2+n_3+1}^{N} f(\epsilon_{j11}, \epsilon_{j21}) \tag{A3}$$

Likewise, the joint probability of observing the sample of n_2 school districts [suppressing the term $Pr(\epsilon_{j22} > -\alpha_2 \mid \epsilon_{j11}, \epsilon_{j21}, \epsilon_{j12}, \epsilon_{j22})$] which pass on the second election is:

$$\prod_{j=n_3+1}^{n_2+n_3} f(\epsilon_{j12},\epsilon_{j21},\epsilon_{j12},\epsilon_{j22}) \tag{A4}$$

The joint probability of observing the other n_3 districts is:

$$\prod_{j=1}^{n_3} f(\epsilon_{j11},\epsilon_{j12},\epsilon_{j21},\epsilon_{j22},\epsilon_{j13},\epsilon_{j23}) \tag{A5}$$

The probability of observing the entire sample is given by the product of (A3), (A4), and (A5):

$$\prod_{j=n_2+n_3+1}^{N} f(\epsilon_{j11}, \epsilon_{j21}) \prod_{j=n_3+1}^{n_2+n_3} f(\epsilon_{j11}, \epsilon_{j21}, \epsilon_{j12}, \epsilon_{j22}) \times$$

$$\prod_{j=1}^{n_3} f(\epsilon_{j11}, \epsilon_{j21}, \epsilon_{j12}, \epsilon_{j22}, \epsilon_{j13}, \epsilon_{j23})$$

Define

$$u_{j2} = [\epsilon_{j11}, \epsilon_{j21}] \qquad j = n_2+n_3+1, \ldots, N$$

$$u_{j4} = [\epsilon_{j11}, \epsilon_{j21}, \epsilon_{j12}, \epsilon_{j22}] \qquad j = n_3+1, \ldots, n_2+n_3$$

$$u_{j6} = [\epsilon_{j11}, \epsilon_{j21}, \epsilon_{j12}, \epsilon_{j22}, \epsilon_{j13}, \epsilon_{j23}] \qquad j = 1, \ldots, n_3$$

We assume that u_{jk} is $N(\underline{0}, \Sigma_k)$ $k = 2, 4, 6$

where Σ_6 is a 6x6 covariance matrix with entries given by (13)-(33), and Σ_2 and Σ_4 are the appropriate 2x2 and 4x4 upper left-hand submatrices of Σ_6.

The joint density of the ϵ's is

$$(2\pi)^{-n_1} |\Sigma_2|^{-n_1/2} \exp\{-(1/2) \sum_{j=n_2+n_3+1}^{N} u_{j2} \Sigma_2^{-1} u_{j2}'\}$$

$$(2\pi)^{-2n_2} |\Sigma_4|^{-n_2/2} \exp\{-(1/2) \sum_{j=n_3+1}^{n_2+n_3} u_{j4} \Sigma_4^{-1} u_{j4}'\} .$$

$$(2\pi)^{-3n_3} |\Sigma_6|^{-n_3/2} \exp\{-(1/2) \sum_{j=1}^{n_3} u_{j6} \Sigma_6^{-1} u_{j6}'\}$$

We wish to transform this to the density of the observed endogenous variables E_t and V_t. For observation j the determinant of the Jacobian of this transformation is

$$(E_{1j} - \rho A_j)^{-1} \qquad j = n_2+n_3+1, \ldots, N$$

$$[(E_{1j} - \rho A_j)(E_{2j} - \rho A_j)]^{-1} \qquad j = n_3+1, \ldots, n_2+n_3$$

$$[(E_{1j} - \rho A_j)(E_{2j} - \rho A_j)(E_{3j} - \rho A_j)]^{-1} \qquad j = 1, \ldots, n_3$$

Let

$$W_1 = \sum_{j=1}^{T} \ln(E_{1j} - \rho A_j)$$

$$W_2 = \sum_{j=1}^{n_2+n_3} \ln(E_{2j} - \rho A_j)$$

$$W_3 = \sum_{j=1}^{n_3} \ln(E_{3j} - \rho A_j)$$

Then the log-likelihood function is

$$L = \text{const.} - (1/2)[n_1 \ln|\Sigma_2| + n_2 \ln|\Sigma_4| + n_3 \ln|\Sigma_6| + \text{tr}(U_2 \Sigma_2^{-1} U_2')$$
$$+ \text{tr}(U_4 \Sigma_4^{-1} U_4') + \text{tr}(U_6 \Sigma_6^{-1} U_6')] - W_1 - W_2 - W_3$$

where

$$U_2 = [\underline{C}_1 - \underline{XB}_1, \underline{V}_1 - \underline{1}\alpha_1]$$

$$U_4 = [\underline{C}_1 - \underline{XB}_1, \underline{V}_1 - \underline{1}\alpha_1, \underline{C}_2 - \underline{XB}_2, \underline{V}_2 - \underline{1}\alpha_2]$$

and $U_6 = [\underline{C}_1 - \underline{XB}_1, \underline{V}_1 - \underline{1}\alpha_1, \underline{C}_2 - \underline{XB}_2, \underline{V}_2 - \underline{1}\alpha_2, \underline{C}_3 - \underline{XB}_3, \underline{V}_3 - \underline{1}\alpha_3]$

FOOTNOTES

1. See, e.g., Feldstein (1975) and Slack (1980). Johnson (1979) recognizes the importance of treating governments as something different from "perfect preference aggregators," but does not explicitly model a political process.

2. See, e.g., Megdal (1982), who recognizes the importance of institutional structure. She takes great care in capturing the state aid formula in her regressions. She nonetheless asserts that "median voter" politics characterize her entire sample, which consists of New Jersey school districts with quite diverse institutions.

3. See, e.g., Slack (1980).

4. See, e.g., Gramlich (1977), Whitman and Cline (1978), Johnson (1979).

5. In addition to the works cited in the text, agenda control in the context of public expenditures has been explored by Denzau and Mackay (1980) and Mackay and Weaver (1978).

6. The most frequently invoked (by economists) such model is the "median voter" framework. Although usually not explicitly specified, implicit in this model is the assumption of open or competitive agendas, with no restrictions on access to the agenda.

7. These remarks apply to the Oregon institutional structure prior to 1979. The actual number of elections allowed was subject to change by state legislation. The limit has never been more than eight elections. For the period covered by the data we used in this paper, the limit was six.

8. Beck (1981) acknowledges reversion effects in his model of Michigan school spending. But even though there is substantial and complex variation in reversions among Michigan school districts, Beck assumes zero reversions — school closings — for all districts in his empirical work.

9. These findings are consistent with the oft-cited "flypaper effect" of intergovernmental aid (see, e.g., Gramlich, 1977; Whitman and Cline, 1978). The tendency for spending to increase by roughly the amount of such aid is consonant with and reinforced by the setter's behavior.

10. Courant et al. (1979) and Oates (1979) have also offered arguments for "flypaper" due to perception effects. For a brief critique of these arguments, see Filimon et al. (1982).

11. In general, the voting effect of the setter's error will depend on the entire distribution of voters' preferences. Consequently, δ may vary from one district to another. Constraining δ to be constant is a strong assumption.

12. Our use of medians in the empirical specification should not be taken to mean that we regard a "median" voter as pivotal. The "multiple" and "fractile" identification problems discussed in Romer and Rosenthal (1979b) imply that one cannot conclude from a loglinear model that a "median" voter is decisive (in the case of a median voter model) or pivotal (in the case of a setter model). Moreover, even if preferences are single-peaked and there is full turnout, we cannot expect the voter with median demand to be at the median on every independent variable, except under very restrictive conditions. Consequently, we do not view the equation for the proposal of the setter to be a vehicle for identifying whether a voter with specific characteristics is decisive or pivotal.

13. For more details on the use of this approximation, see Filimon, et al. (1982).

14. We experimented with a modified version of the "learning update" by hypothesizing that adjustments occur only if the first election loses by more than a given percentage of votes; thus,

$$\text{"Learning Update"} = \begin{cases} 0 & \text{if } V_1 \geq \bar{\alpha} \\ -s(V_1 - \alpha_1)/\delta & \text{if } V_1 < \bar{\alpha} \end{cases}$$

Here $\bar{\alpha} < 0$ is a prespecified parameter. We estimated the system on two-election data for several values of $\bar{\alpha}$, corresponding to a range of first election vote outcomes from 30% Yes to 49% Yes. The likelihood function was maximized for $\bar{\alpha}$ corresponding to an approximately 47% Yes vote. The estimated parameters were essentially identical to our original estimates. Allowing for a "zone of indifference" did not alter our finding that the update parameter s is not significantly different from zero.

15. We computed $\ln(E_1 - \rho A) \pm \sigma_u$ at the sample means of E_1, A and $\rho = 0.975$. $917 and $1000 correspond to the values of E_1 implied by this computation.

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